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JOURNAL

OF THE

New-York Microscopical Society.

Vol. II.

INC. 1877.

26192
13/3/93

NEW-YORK :
PUBLISHED FOR THE SOCIETY.

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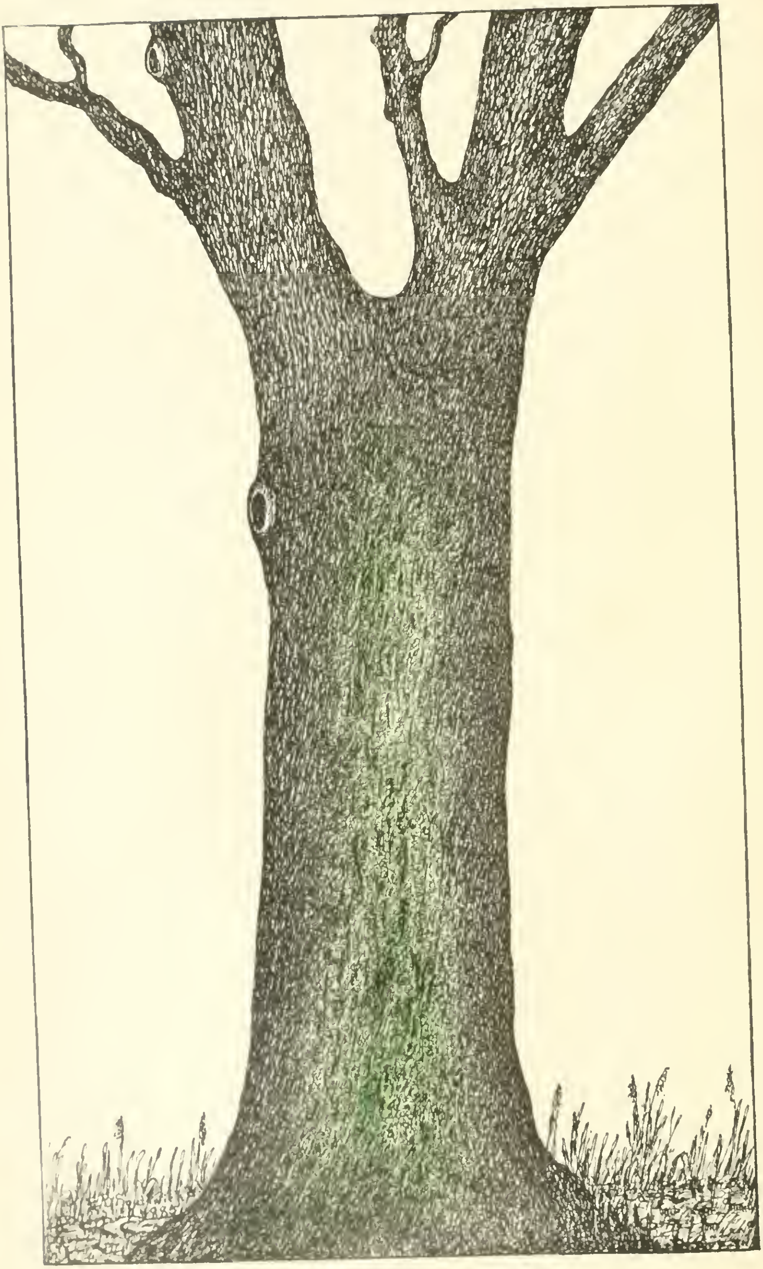
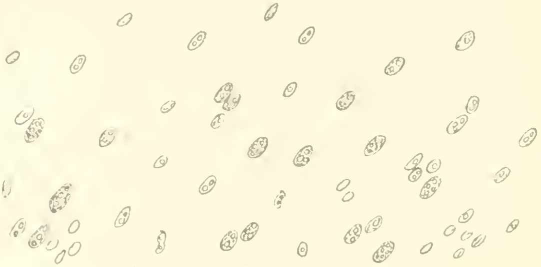


PROTOCOCCUS VIRIDIS IN SITU ON ELM.



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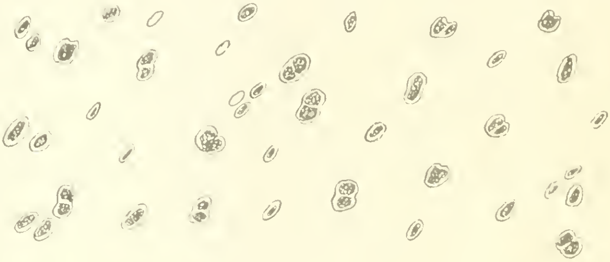

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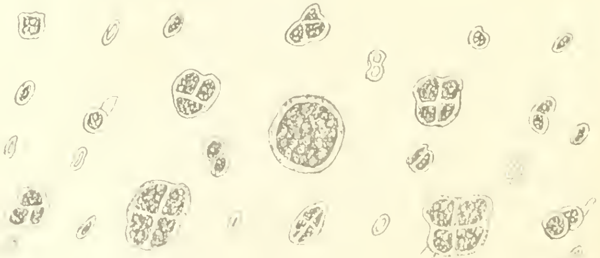

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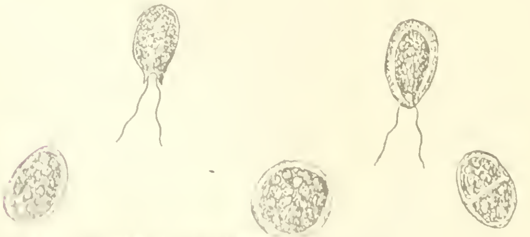

[illegible] Protococcus pluvialis

JOURNAL
OF THE
NEW-YORK MICROSCOPICAL SOCIETY.

VOL. II. JANUARY, 1886. No. 1.

PROTOCOCCUS VIRIDIS.

BY E. B. SOUTHWICK.

(*Read Dec. 18th, 1885.*)

The microscopic plant to which your attention is called this evening is classed among the Protophyta, the sub-kingdom containing certain imperfectly known genera which are in all probability but degraded forms of Algæ, such as the families *Rivularieæ*, *Oscillarieæ*, *Nostochineæ*, *Palmelleæ*, and *Volvocineæ*.

They are gelatinous organisms found on damp stones, trunks of trees, and the earth, in fresh water either cold or thermal, rarely in the sea, and are composed either of globules or of simple or branched filaments continuous or chambered, and nearly always enveloped in mucilage.

Protococcus, the genus under consideration this evening, includes various unicellular *Palmellaceæ*. They increase by division into two or four parts, which separate, but are connected by a semi-gelatinous layer. Sometimes its cells give rise to four ciliated zoöspores of two sizes, the larger of which settle down and develop a cellulose coat, while of the farther development of the smaller, nothing is known. The famous Red Snow of the *Arctic* regions and the *Alps*, which is also found on stones in fresh-water streams, belongs to this *genus*, and is known as *Protococcus nivalis*.

Protococcus viridis grows on the trunks of trees, on stones, on patches of mortar, and apparently in most places sufficiently moist and shaded to induce its growth.

As observed in Central Park, New York city, it is chiefly on the northern and the northwestern exposures, being most abundant on many trees near the ground. On those favorable for the retention of moisture and sufficiently shaded, the *Protococcus* is apparently as luxuriant fifteen feet above, as at the base. Different species of trees seem to be more or less favorable to its growth, and often the shade of a limb protects it from the rays of the sun and the beating rain. On the European Beech (*Fagus sylvatica*) it is abundant at the base of the tree only ; at the height of two feet, little is found. The bark, being of a hard, close texture, does not favor its growth. On the Red Maple (*Acer rubrum*) it does not seem to be abundant. The bark, although rather soft, is not hygroscopic, and therefore does not favor its development. On the American Elm (*Ulmus Americana*) the growth is most luxuriant, extending to a great height, the soft spongy bark being favorable to it. On the Scotch Pine (*Pinus sylvestris*) the growth is apparently very feeble, and under the microscope the cells were seen to be scarce and in small detached clusters of from four to six. The outside of this bark is of a corky nature and apparently not hygroscopic. The color is very dark, with patches of a whitish substance, which under the microscope was found to be covered with a minute lichen thallus of extreme delicacy and beauty, having a concave surface and finely fringed edges ; with this growth but few *Protococci* were found, the thallus of this minute lichen contesting with them the right of occupancy. On the Norway Spruce (*Abies excelsa*) the growth seems to be most luxuriant on the branches and upper portions of the tree, the lower part of the trunk being too dry.

In many specimens examined the gelatinous substance seemed to be of sufficient consistency to hold the smaller particles of quartz and foreign matter ; in many cases the uplifting mass of growth was seen to carry upon it a great number of these particles. On the Tulip Tree (*Liriodendron tulipifera*) the growth was the most luxuriant of any examined and the foreign matter was less abundant, probably because the rapid growth standing out in large projecting clusters had covered it. On the Catalpa (*Catalpa bignonioides*) the plant had apparently been vigorous, yet when examined under the microscope it was found to be of a dark green, and not of that bright yellow green so characteristic of vigorous growth.

On the European Larch (*Larix Europaea*), the growth was not vigorous on the trunk, while on the branches and upper portions of the stem it appeared stronger, showing that on the bark of the younger wood it found a more congenial habitat. Under the microscope the masses were quite flat, and among them were observed quantities of a white, granular matter. On the Hibiscus (*Hibiscus Syriacus*) the growth was of the finest character, and hyphæ were observed in a budding process, having from two to six branching cells ; below the hyphæ were the large masses of *Protococcus* cells which had been produced by fission, mostly in twos and fours, standing out in projecting clusters. In this specimen and in many others examined, several brownish buds, probably of another species of *Protococcus*, were found, showing growth by gemmation as well as by fission, and with abundant hyphæ.

On the White Birch (*Betula alba*) the growth is chiefly confined to those broken portions of the bark which present a rough surface for the retention of moisture and the collecting of foreign matter. Under the microscope the growth was seen to be scanty, yet the hyphæ-bearing cells were abundant. On the Hemlock (*Tsuga Canadensis*) it was very abundant and of a bright yellow green, and the gelatinous mass was so strong that when placed under the cover glass of a slide in water they were with difficulty separated. On the Deciduous Cypress (*Taxodium distichum*) the plant was more vigorous than on any other coniferous tree, the soft spongy bark being well adapted for its growth. On the west side of the Park walls, along Fifth and Eighth avenues, the growth is so abundant that the coping and three tiers of Nova Scotia sand-stone have a bright green color. The next tier, of North River blue-stone, has very little upon it, and on the basal course of Gneiss none is apparent, yet on the mortar it is abundant. On the Terrace north of the Mall, the Nova Scotia sand-stone on the northern and the western exposures is covered with a rich growth, and no doubt this is one of the causes of the disintegration of the stone. The *Protococcus* holding moisture, and the expansion by freezing breaking down the small particles of stone. On the south side of the transverse road the growth is abundant, while on the north side but little is seen.

In treating the trees in the Central and other Parks of New York with polysolve, a preparation used for the destruction of insects, the *Protococcus* was apparently killed. But during the month of August, about a week after the trees had been cleaned, a rain-storm set in, which lasted nearly three days. The growth on the trees that had been cleaned was apparently as vigorous as on those that had not, giving the impression that the polysolve had either not killed the *Protococcus*, or that a new growth had rapidly been formed from the germs in the air.

The following is a list of 100 trees which are prominently affected with *Protococcus viridis* in Central Park.

Magnolia glauca, Linn.
 acuminata, Linn.
 cordata, Michx.
 macrophylla, Michx.
 Umbrella, Lam.
 conspicua, Salisb.
 On the Magnolias the growth is only near the ground and not abundant.

Liriodendron tulipifera, Linn.—Luxuriant, and of a bright yellow green color.

Tilia Americana, Linn.
 Europæa, Linn.
 heterophylla, Vent.
 alba, Waldst and Kit.
 Not abundant, and chiefly at the base.

Ptelea trifoliata, Linn.—Abundant and luxuriant.

Ilex Dahoon, Walter.
 opaca, Ait.
 Not abundant, and near the base.

Euonymus atropurpureus, Jacq.
 Europæus, Linn.
 Abundant on both trunk and branches.

Rhamnus catharticus, Linn.—Little if any was observed upon this tree ; the bark does not seem to be a suitable habitat.

Æsculus Hippocastanum, Linn,
 flava, Ait.
 Californica, Nutt.
 Neither abundant nor vigorous.

Acer Pennsylvanicum, Linn.
spicatum, Lam.
circinatum, Pursh.
saccharinum, Wang.
dasycarpum, Ehrht.
rubrum, Linn.
plantanoides, Linn.
pseudo-platanus, Linn.
On *Acer rubrum* and *Acer dasycarpum* the growth does not seem to be as vigorous as on the remaining species.

Negundo aceroides, Mœnch.—Abundant and vigorous.

Robinia Pseudacacia, Linn.
viscosa, Vent.
Quite abundant, but apparently not vigorous.

Gymnocladus Canadensis, Lam.—Very little was observed on this tree.

Gleditschia triacanthos, Linn.—Not abundant, and in small detached masses.

Cercis Canadensis, Linn.—A very small quantity at the base only.

Prunus serotina, Ehrht.—Abundant at the base only, the bark apparently too hard for its growth.

Pyrus Americana, D. C.—Abundant and vigorous.

Cratægus Crus-galli, Linn.
coccinea, Linn.
Oxyacantha, Linn.
tomentosa, Linn.
Growth not abundant, and weak.

Amelanchier Canadensis, Torr. and Gray.—Abundant and vigorous.

Hamamelis Virginica, Linn.—Very little was found on this tree.

Cornus Florida, Linn.—This tree does not seem adapted to its vigorous growth, as very little was found, and then at the base only.

Nyssa sylvatica, Marshall.—Not abundant, and only near the base.

Diospyros Virginiana, Linn.—Not abundant, and at the base of the tree only.

Halesia tetraptera, Linn.—Growth very abundant and vigorous at the base; where the trees were leaning, the growth extended well up on the trunk.

Fraxinus Americana, Linn.
  pubescens, Lam.
  viridis, Michx. f.
  excelsior, Linn.
  On the ashes the *Protococcus* finds a suitable habitat, as it is abundant and vigorous.

Catalpa bignonioides, Walt.—Abundant.

Paulownia imperialis, Sieb.—Abundant near the base.

Sassafras officinale, Nees.—Not abundant nor vigorous.

Ulmus Americana, Nutt.
  fulva, Michx.
  racemosa, Thos.
  campestris, Linn.
  Montana, Bauh.
  Growth vigorous and in great abundance.

Celtis occidentalis, Linn.—Very little found.

Morus rubra, Linn.
  alba, Linn.
  Very little found.

Maclura aurantiaca, Nutt.—Not abundant.

Platanus occidentalis, Linn.
  orientalis, Linn.
  On patches of the bark from which the outer portion had fallen off last year.

Juglans nigra, Linn.
  cinerea, Linn.
  On these the growth is neither abundant nor vigorous, and on many none could be found.

Carya alba, Nutt.
  porcina, Nutt.
  amara, Nutt.
  In a group of several of these trees the *Protococcus* was found on *C. porcina* only, and on that but sparingly.

Quercus alba, Linn.
  macrocarpa, Michx.
  bicolor, Willd.

Prinus, Linn.
obtusifolia, Michx.
rubra, Linn.
coccinea, Wang.
tinctoria, Willd.
palustris, Du Roi,
cerris, Linn.
pedunculata, Willd.
sessiliflora, Sal.

On the White Oaks the growth was apparently not as vigorous as on the Black and the Red Oaks, and on none of them was it abundant or vigorous.

Castanea vesca, Gærten.
Americana, A. De Cond.

Not abundant nor vigorous.

Ostrya Virginica, Willd.—Very little was found on this tree, and that near the base.

Betula papyrifera, Marsh.
alba, Linn,
alba, var. *populifolia*, Spach.

The growth was confined to the broken patches of bark, or to places where the outside had been taken off.

Betula lutea, Michx. f.
nigra, Linn.
lenta, Linn.

Not abundant nor vigorous.

Alnus serrulata, Willd.
incana, Willd.
glutinosa, Gærten.

Very little was observed on these trees, and at the base only.

Salix alba, Linn.
Babylonica.

Very little, and at the base only.

Populus grandidentata, Michx.
monilifera, Ait.
balsamifera, Linn.

Not abundant.

Thuja occidentalis, Linn.—Abundant near the base of the tree.

Juniperus Virginiana, Linn.—None was observed on this tree.

Taxodium distichum, Richard.—Abundant and luxuriant, chiefly at the base of the tree.

Sequoia gigantea, Decaisne.—None observed on this tree.

Pinus strobus, Linn.

sylvestris, Linn.

Very little was found on *P. sylvestris*, but on *P. strobus* the growth at the base of the tree was quite abundant; on scars where the limbs had been severed, the pitch that had exuded was being gradually grown over with *Protococcus*.

Pinus mughus, Jacq.—The trunk and branches of this small pine were completely covered with a vigorous growth.

NOTES ON PROTOCOCCUS VIRIDIS.

BY P. H. DUDLEY.

(*Read December* 18*th*, 1885.)

We have just heard the little plant under consideration classed among the lowest orders of vegetation. Huxley goes further, and says, "*Protococcus* and *Torula* (yeast plant) are the representatives of the two great contrasting types of the beginning of plant life." Though each is of but simple cell structure, their physiological functions are directly opposite. The first builds up from simple to complex protein compounds ; the latter reduces complex compounds to simple ones, obtaining its protein matters from higher organisms.

Protococcus in sunlight decomposes carbon di-oxide, utilizes the carbon in its structure, and sets part of the oxygen free, as do the higher plants. *Torula*, on the other hand, absorbs oxygen and throws off carbon di-oxide. *Protococcus viridis* is filled with chloro-plastids, their absence in *Torula* enables us to distinguish between them at a glance.

All the complex plants have cells of the same physiological features as either *Protococcus* or *Torula*, which fact divides them into two groups, first, those like the *Protococcus*, which give the beautiful verdure to the landscape, while the fungi represent the latter.

As humble as our plant may seem from its classification, modern science is still unable to solve its mysteries ; it is one of the great manufacturing chemists, among plants, converting crude materials into combinations which, upon decay, may be taken up by higher vegetation. Spread out upon trees and rocks, its gelatinous substance is ready to catch and imbed the floating dust and inorganic matter brought to it by the wind, some of which will be converted and used. The air also brings great carboys of carbon di-oxide and exchanges them for oxygen. Fumes of sulphuric, sulphurous, nitric and nitrous acids, and also ammonia come to be combined ; the rain brings chlorides and other chemicals to be utilized. Each of the individual cells of the *P. viridis*, only measuring from two to ten micro-millimetres in diameter, can do more in its small laboratory than our chemists with all the room and appointments that science has suggested—it builds its own cellulose walls from inorganic matter. Chemists are hardly agreed upon the composition of cellulose and the protein compounds, and, if they were, they could not introduce the life principle to produce them. In looking at the cells under a microscope we must be content with little more than an exterior view, only dimly seeing, through the translucent walls, the wonders within. With the best objectives skilful opticians have placed in our hands, which I would say in passing are among the triumphs of science and art, we cannot find the door of this wonderful laboratory to enter and see, much less to understand, the contents of the crucibles, retorts, the stock of reagents and minerals used. We cannot see the prisms and lenses which divide the rays of light to act upon the chlorophyll, inducing chemical affinity, so as to produce compounds of starch, sugar, or cellulose, as the case may be. No exhibit will be given of the mechanism transforming light into electricity, polarizing the atoms, or arranging them into different forms according to the number present. We can only wonder whether the salts of potassium, calcium, magnesium and sodium are of first importance in the compounds produced, or are bullion for the mints of the higher plants. Calling to our aid the various chemical reagents, we are almost equally baffled.

Placing under the microscope *Protococcus*, on stone, or on a piece of bark, with a power of fifty, we see budded club-shaped masses, standing out in relief, with some imbedded sand and a few branches of hyphæ. If we remove some to a glass slide, add a drop of water, and gently tap the cover glass to separate some of the buds, and then view with a power of 200, cells of various sizes are seen, some round, others subdividing into twos, threes, fours, &c. The subdivisions into twos or fours are not as elliptical as those shown of *P. vulgaris* and *P. pluvialis*, but with rounder ends, as shown by Kutzing. The cellulose wall is plainly seen enclosing the greenish protoplasm, with a few darker spots of green. Some of the cellulose sacs will be seen to be empty and clear. By increasing the power to 500, the greenish spots become larger, but generally indistinct, though this is not the case in all slides. Specimens from different trees show different details. Our specimens were collected in November and December to date, which must be considered.

In all probability the full cycle of development of *P. viridis* in its habitat, cannot be determined without observations extending through the different months of a year, at least. Mr. Southwick reports some trees as covered quickly during storms, after he had cleaned them. Whether his solutions failed to destroy all the germs, or they were supplied from other sources, is being investigated. November 23d a heavy N. E. storm began in this vicinity, $1\frac{18}{100}$ inches of water fell in 24 hours, about $\frac{1}{40}$ of the usual yearly rain fall. On the 24th the rain-fall was $\frac{16}{100}$ of an inch. On the 23d the mean temperature was 35°, max. 38°, miles traveled by the wind, 324. The next day the mean temperature was 38.3°, max. 39°, miles traveled by the wind, 379, according to Dr. Draper's meteorological records in Central Park. On some trees the *P. viridis* seemed to be brighter, more on the north-west side, than before the storm; but no new patches were found, therefore fresh isolated growths did not occur during this storm, and trees which had been just cleaned were exempt, and on the deciduous trees, the water coursing down the bark had removed it, leaving either side green.

In *P. vulgaris* and *P. pluvialis*, resting and motile forms are shown, besides those of subdivision ; in *P. viridis* we looked through a great number of specimens for the motile forms, and only found them in specimens collected during the last two or three days. I had examined many which were dry when frozen, and found only a few, but on taking some from a brick which was hygroscopic, the plant being wet when frozen, I found an abundance of motile forms.

The cellulose sac, which surrounds the protoplasm, was burst, and the latter escaped, assuming an oblong or elliptical form, but not with one end double pointed as figured in *P. vulgaris* and *P. pluvialis.* The statement that these motile forms have two long cilia, so far has not been verified by our investigations. The chloro-plastids seen in the motile forms are round, some having two, and others four or five, giving the appearance of nuclei. Freezing several times does not destroy the motile form, the delicate sac being flexible and elastic. On the shady side of rocks, stone, brickwork and mortar which are porous or hygroscopic, the *Protococcus* grows in greater or less abundance, and in walking through the cross-streets of the city, one cannot fail to notice it on the basement steps and railings on the south side of the street, in contrast to its absence on the north, By helping to retain moisture, great aid is given to the disintegration of the rocks and stone work, especially by the dissolving power and then the freezing of the absorbed water. Under some of the flakes which came off from the obelisk, I found an abundance of one and two cells of the genus *Protococcus*, the germs of which must have passed through the small exterior cracks and crevices with the rain water: these had only two divisions instead of four as found in *P. viridis.* Several other cells and spores were found, some of which had been probably imported. If the cells of *Protococcus* formed and subdivided under the flakes, then the growth of chloro-plastids took place in translucent light. They were light yellow green, which became blue green upon wetting, and exposure to sunlight. On the duramen of soft woods, after sufficient exposure to soften the fibres, forming lint, *P. viridis* will grow readily. Its appearance on white cedar trees is usually the first evidence of their softening. The effect of reagents upon the cells is very interesting : concentrated ammonia swells them out nicely for examination—many of the specimens here are mounted in that medium. Caustic potash is more severe, and changes the green color. Alcohol contracts the protoplasmic contents. Hydrochloric acid changes the green cells to more of a yellow, and shows the cellulose wall plainly. Iodine solution colors them brown, showing the chloro-plastids, and the contents in the hypha. The indications of starch grains are too much obscured by the iodine to be traced, without special treatment. Sulphuric acid added to iodine, colors the cell walls blue in most cases, showing that it is cellulose. In fresh growing specimens the surrounding gelatinous matter will be colored blue, showing that it is at first cellulose, but later undergoes mucilaginous transformation so as to be no longer recognized as cellulose. I have here some alcoholic extracts of the chlorophyll; cold alcohol does not extract the color quickly, ānd must be boiled for two or three minutes—add benzine to the product, gently shaking it, let it stand a moment—the benzine has dissolved the dark blue green and rises to the top of the alcohol extract, which is now of a light yellow green color.

Krauss calls the former xanthophyll, and the latter kyanophyll, and held with others that the two represent chlorophyll, and both are components of the same green substance.

According to the investigations of Pringsheim and Weisner it appears that the kyanophyll of Krauss, is relatively pure chlorophyll, but the xanthophyll of Krauss consists of yellow modifications of chlorophyll whose relations to crude chlorophyll are not fully established. They considered that xanthophyll is a mixtue of three yellows, namely, etiolin, xanthophyll and anthoxanthin. Etiolin is the coloring matter which is formed by etiolated growths breathing in the darkness.

A NEW HIGH-REFRACTIVE MOUNTING MEDIUM.

BY PROF. H. L. SMITH.

(*Read Dec.* 18*th*, 1885.)

Since the publication of the formula for a new mounting medium composed of stannous chloride and glycerine jelly,[1] I have made what appears to be a very great improvement, by substituting bromide of antimony for the stannous chloride, and boro-glyceride for the glycerine jelly. The boro-glyceride has been prepared for me by Mr. C. F. Booth (Tarrant & Co., Manufacturing Chemists, N. Y. City), and was first brought to my notice by this gentleman. I use a 50 *per cent.* solution of this, and it appears, so far, to answer admirably as a substitute for the gelatine, and it possesses the advantage of making a much more solid mount. Antimony bromide is somewhat more expensive than stannous chloride, but it works very kindly in making mounts ; the compound can be readily made by any one, and as only a moderate heat is required it can be made in the bottle in which the medium is to be kept. As the moisture of the air will affect this medium, it will be better to prepare it, or at least to keep it, in glass-stoppered bottles. Rubber corks, or indeed the ordinary corks, do not appear to be much affected by it, still a suitable glass-stoppered bottle is to be preferred.

[1] American Monthly Microscopical Journal, Vol. VI., No. 9, Sept., 1885.

When it is properly prepared, and care is used not to overheat, the medium will be of a deep amber color, and will make mounts which are almost absolutely colorless. The refractive power is considerably more than can be obtained with the stannous chloride medium. As the boro-glyceride alone becomes hard upon heating and evaporating the excess of gelatine, we can, if for some objects a medium of lower refractive index is desired, make the compound to have whatever refractive power may be necessary up to fully 1.8, or, it may be, more. The specimen which I send herewith for inspection by the Society, was made in the stock bottle without any attempt at the purification or filtering of the solution. The medium is used in the same manner as balsam, and, if properly made, will have the consistency of thick balsam ; a small dip is taken out on a glass rod and applied to a warmed slide, and on this the cover is placed, the diatoms having been previously dried and burned upon it. The whole is now heated and boiled, as in making a balsam mount. The boiling is prolonged somewhat more perhaps than in making a balsam mount, but the medium works very kindly, and the cover will settle down and the bubbles all disappear on cooling ; if not, the heat can be again applied and the few remaining bubbles coaxed out, and now, if the boiling has been sufficiently prolonged, the cover will be found as securely fixed when the slide is quite cold, as it would have been if Canada balsam treated in the same way had been used. As the material remains soft with comparatively little heat, the slide must be entirely cooled before proceeding to clean off the excess of the medium, if there be any. As the medium is quite soluble in water (which, however, turns it white), the excess can be easily and quickly removed by using a little roll of moistened tissue paper ; and without any fear of disturbing the mount, the slide and all around the cover must be wiped quite dry, and, to insure this, perhaps a slight reheating will be best. If, however, reheating is indulged in, the slide must be allowed to cool before applying the finishing ring.

I have been using a cement made of gold size and litharge, which dries rapidly, and appears to make an excellent, tough, and hard finishing ring. I prefer, however, the wax ring, punched out from the ordinary sheet wax as prepared for artificial flowers. One of these rings can be picked up from the flat table, by placing the slide upon it with the cover of the mount down, so as to insure the cover being central with the ring, and using very slight pressure, for otherwise the wax would adhere to the table. When the ring has been picked up in the right position, the heat of a small flame is cautiously applied under the slide, until the ring softens, and settles down first on one side, and then, following round under the ring cautiously, until the wax is just melted, but not so as to run, which would spoil the symmetry and beauty of it ; if an air bubble is entangled, it may be touched while the wax is still melted, with a hot pin point, or point of forceps warmed. As soon as the ring has been all melted the slide can be put on the table, to let the wax harden, and as soon as the slide is thoroughly cooled, the wax ring and cover can be rubbed vigorously, and the ring polished. These rings will bear any amount of rubbing, and do not need any subsequent applications of varnish, though there would be no objection to the use of them, either for ornament or for a still more efficient protection of the mount. I have recently made some mounts, sealing them in another manner, which appears to answer well ; rings are punched out of paper about the thickness of the cover, and with a central opening of the same size as the cover. After making the mount and cleaning it, one of these rings is placed on the slide, having the cover just coming through the opening, flush with the surface. Then a bit of paraffine is placed on one side and melted ; of course, it flows in and under and saturates the ring, and runs in between the inner margin of the ring and the cover ; the whole is now cooled, and rubbed vigorously, thus removing the excess of the paraffine. These mounts appear to keep well.

Formula—2 fluid-drams boro-glyceride, 50 *per cent.* solution, 1⅓ oz. antimony bromide.

Warm the boro-glyceride solution, and add the antimony bromide in small portions, heating until all is thoroughly dissolved; the heat must be applied carefully to avoid browning, but must be sufficient to dissolve thoroughly the bromide ; on cooling, the mixture will be nearly solid, and will measure somewhat more than one fluid-ounce. In conclusion, I may say, that while the boro-glyceride appears to answer so admirably for antimony bromide, I do not find it quite equal to the gelatine for stannous chloride. It will not permit so much to be dissolved, and does not act as kindly As the result of all my experiments, I am disposed to give the preference to the antimony and boro-glyceride.

To make a handsome mount, it is quite important that all excess of the medium outside the cover should be removed, as the antimony will discolor more or less the wax ring, or any cement now known to me.

PROCEEDINGS.

MEETING OF DECEMBER 4TH, 1885.

The President, Mr. C. Van Brunt, in the chair.

Thirty-five persons present.

OBJECTS EXHIBITED.

1. Diamond-Beetle : by M. H. EISNER.

2. Silicified Coniferous Wood from Arizona : by C. S. SHULTZ.

3. Transverse section of the peduncle of *Nymphæa odorata*, showing intercellular hairs : by BENJAMIN BRAMAN.

4. Section of injected human brain : by WM. G. DE WITT.

5. Silicified wood from the Yellowstone National Park : by WM. G. DE WITT.

6. *Mesocarpus* in conjugation ; mounted by A. C. Cole, of London : by A. D. BALEN.

7. Fibrous Malachite from the Copper Queen Mine, Arizona : by M. M. LE BRUN.

8. Silicified wood from Arizona, showing the mycelium of a Fungus : by M. M. LE BRUN.

9. Silicified wood from Arizona : by L. SCHÖNEY, M. D.

10. Pollen of *Strelitzia Reginæ*, mounted in glycerine : by N. L. BRITTON.

11. Section of "Tiger's Eye" from Arizona : by C. S. SHULTZ.

ELECTRICAL ILLUMINATION FOR THE MICROSCOPE.

Mr. E. A. Schultze remarked on his recent experiments on the production and use of the incandescent electric light. He had tried many forms of batteries for the production of the current, but had found them all unsatisfactory, as the best of them required cleansing, and renewal of chemicals, after running for about three hours. He then attempted the use of a small steam engine fed by illuminating gas, to drive a dynamo. He abandoned this method after ascertaining that no engine of moderate size would give sufficient rapidity to the generator, and that the vibrations imparted to the floors precluded the use of high-power lenses : it was objectionable for other reasons also. He then procured a small gas engine, which was placed in an adjoining room. This gave sufficient rotary velocity to the dynamo to produce a light of between two and three candle-power, and was eminently successful. The engine required no attention, and the noise was barely perceptible. The light is attached to the microscope-stand by a double ball and socket joint, and can thus be placed in any position. It possesses great resolving power, and the advantages of direct illumination over reflected light from the mirror are very pronounced. Mr. Schultze preferred the Swan lamp over all others, there being no projecting point on top, due to closing the bulb after exhaustion.

Mr. De Witt suggested the advantage of using the electric light in the study of minute organisms with the apparatus employed by Messrs. Drysdale and Dallinger, and described in Kent's Infusoria, plate LI. They were obliged to tilt the microscope to a horizontal position to obtain the required illumination ; this difficulty would be avoided by the use of the Swan lamp.

An agent of the Gibson Storage Battery Co. exhibited a battery of two storage cells, producing a light of one candle-power, which would run continuously for two and three-quarters hours. The cells might be charged from the arc-light or incandescence lamp currents, or from gravity or other cells.

POLLEN OF STRELITZIA.

Referring to the slide exhibited, Dr. N. L. Britton described the pollen as nearly globular and very large. It is mentioned in Edgeworth's "Pollen", p. 17, where its size is given as $\frac{25}{6000}$ of an inch, which is about 100 μ. The grains are filled with granular protoplasm, readily seen with a two-inch objective. Their color is white.

MEETING OF DECEMBER 18TH, 1885.

The President, Mr. C. Van Brunt, in the chair.

Thirty-one persons present.

OBJECTS EXHIBITED.

1. *Protococcus viridis* from Central Park, N. Y., and its vicinity: by E. B. SOUTHWICK and P. H. DUDLEY.

2. *Eozoön Canadense* from Petite Nation, Canada: by A. WOODWARD.

3. Silicified Wood from Fredericksburg, Va.: by A. WOODWARD.

4. Surface of *Amphibius imperialis*, a beetle, from South America: by M. H. EISNER.

5. Embryo of Chick, after 48 hours' incubation; mounted by Prof. H. L. Smith: by F. H. LEGGETT.

PROFESSOR H. L. SMITH'S NEW HIGH-REFRACTIVE MOUNTING MEDIUM.

President Van Brunt: "Prof. H. L. Smith has devoted much time to this subject, and the number of substances he has examined is very great. He has given the formulæ of many compounds of a high refractive index—a sulphur compound—an arsenical compound—stannous-chloride and glycerine. Also stannous-chloride and glycerine gelatine, and others, the most of which have not stood the test of time.

"How far this new compound will answer the purpose time only can determine, although the probabilities of permanence are in its favor.

"The stannous-chloride and glycerine compound is permanent unless too much of the salt has been dissolved in the glycerine. In such a case it is apt to crystallise on the slide after mounting. If too little is used in an effort to mount forms in a medium of lower refractive index, the material is too fluid, and the forms move. The addition of gelatine is objectionable for several reasons.

"This new medium, is entirely different from the others in having a new material, boro-glyceride, for the base. This is in its glacial condition and quite hard. Prof. Smith uses it with one-half ˉpure glycerine; that he calls a 50 *per cent.* solution. Mr. Booth states that it is simply a solution of 92 parts of glyceride and 62 parts of boracic acid, nearly an-hydrous, mixed at a temperature of 300° F., and that it is not a chemical combination but a mechanical mixture, and is readily separated into its original materials.

"This medium is unchangeable when protected from the air, but when exposed to it, rapidly absorbs moisture. It is a solid at ordinary temperatures, is an antiseptic, dissolves readily in absolute alchohol, and would seem to be a far better medium than glycerine gelatine for mounting, without the addition of bromide of antimony; and I think that Mr. Booth should be thanked for suggesting so valuable an addition to the list of mounting mediums.

"Antimony bromide, which is rather an uncommon salt, gives the high refractive index to this base. This salt is readily decomposed. Water is not a solvent, but separates the antimony, precipitating it in the form of a white powder.

"This salt is soluble in the 50 *per cent.* solution of boro-glyceride and in the proportions given. It does not crystallize on the slide after mounting, but when more of the salt is used it forms a most beautiful polariscope object. These crystals do not form immediately, and, if found on a slide, they can be made to disappear by a slight heat.

"But with this base and this salt a compound can be made of any refractive index, from that of the boro-glyceride to that of the solution given by Prof. Smith, which he states upon the bottle to be 1.8. Each of these solutions becomes hard upon cooling.

"Prof. Smith has used this medium for several months, and there is no reason why it should not be as permanent as the stannous-chloride in glycerine."

THE LATE DR. WM. B. CARPENTER.

The Committee appointed to draft resolutions relative to the death of Dr. William B. Carpenter, reported the following :—

To the New-York Microscopical Society :

Your committee respectfully submit, for your adoption, the following expression of sentiment in view of the death of Dr. William B. Carpenter :—

1. The New-York Microscopical Society feel that through this sad event the microscope has lost one of its greatest masters,

and microscopical science one of its brightest ornaments. For sagaciousness in the interpretation of the disclosures of this instrument, and for conversance with the whole vast field of its explorations, they look upon Dr. Carpenter as without a superior, and almost without a peer.

2. The members of this Society gratefully acknowledge their individual indebtedness to Dr. Carpenter for the guidance, stimulus, and instruction furnished by his great work, "The Microscope and its Revelations." They revere, besides, his genial personal qualities, which, while he was their guest one evening in the fall of 1882, bound him to them in the bonds of a delightful and enduring remembrance.

B. Braman,
New York, Dec. 18th, 1885. J. L. Zabriskie,
Jno. L. Wall,
Committee.

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JOURNAL
OF THE
NEW-YORK MICROSCOPICAL SOCIETY.

VOL. II. FEBRUARY, 1886. No. 2.

THE BEST COVER-GLASS CEMENT.

BY DR. L. HEYDENREICH, OF ST. PETERSBURG.[1]

(*Read Dec.* 18*th*, 1885.)

The best cover-glass cement should be :—

1st. Absolutely hermetic, and should not, under any circumstances, require renewal every year. Two or three coats of the cement, applied at short intervals after an object is mounted, should permanently secure and preserve the object.

2d. It should be as hard as glass, or, if possible, harder.

3d. It should not crack nor become detached, and should be so solidly adherent as to be less likely to break than the glass to which it is attached ; and

4th. It should be insoluble in water or glycerine, or in any liquid used as an immersion medium with objectives.

Notwithstanding the large number of cover-glass cements already known and in use, I think another should be sought for, one which shall conform to the foregoing requirements. That all do not so conform is evident when we hear of the damage caused by the use of cements which fail in effectually preserving microscopical preparations, some of which preparations are of considerable value. As an instance of such damage, I mention the case of the fine collection of nerve-tissues belonging to Jakubowitsch.

We have commercial varnishes which are very hard and durable. Some of them, used in the finishing of carriages, are found, after the lapse of a year, to be in the same condition as when first applied. The varnish used on tin pans in Albumen-factories remains unchanged for a year, although subjected daily, for many hours, to a temperature of 100° R. These and similar varnishes are made of resins, copal, or amber. Of all resins, amber and some kinds of copal are the hardest. Copal-varnish is both hard and elastic; amber-varnish is harder than copal, but not so elastic, and is, consequently, more brittle: hence, for a cover-glass cement, a mixture composed of both should be used. Only the best and clearest kinds of amber (the opaque pieces contain various kinds of minerals), and only the hardest kind of copal (that is, the East-India or Zanzibar copal), should be selected for cover-glass cements. Zanzibar copal is taken from the earth in flat, disk-shaped pieces, varying in dimensions from the size of a pea to the size of the human hand; is colorless, yellow, or of a dark red-brown color, and transparent; the surface, rough. Bombay copal comes in larger pieces, is of a yellowish-red color, has, when broken, a smooth, glassy surface, and is but very slightly inferior in quality to the copal of Zanzibar. Sierre-Leone copal comes in small, ball-shaped pieces, about one inch in diameter, or in pieces resembling drops in shape. All the other kinds are softer than those just described.

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[1] Translated by E. A. Schultze, from *Zeitschrift für Wissenschaftliche Mikroskopie*, Vol. II., pt. 3.

The best solvent for resin, and the one which possesses the most adhesive quality, is linseed-oil varnish, made of pure, old, linseed oil. Neither alcohol, ether, chloroform, nor any other quickly evaporating menstruum should be used. In order to hasten desiccation of the resin, and to obtain for the cement the proper consistency, an etherial oil which, upon drying, will leave a surface perfectly even, should be added to the mixture; and oil of lavender, either alone, or mixed with linseed-oil varnish, is suitable for these purposes.

The resins being thus dissolved in linseed-oil varnish until the solution attains the consistency of syrup, oil of lavender should be added until the mixture becomes thin enough to use in mounting microscopical objects—and the cement is finished.

The property of adhering to glass is increased in the cement by adding to it a small quantity of cinnabar; but such addition causes it to dry less rapidly. In a week from the time of using it the cement becomes dry, and so firm that the finger-nail will make but a slight impression on it. For months it remains in this condition. At the expiration of a year, it is very hard and has a glassy surface.

So much for the component parts. The preparation of this cement being somewhat difficult, it would perhaps be advantageous to buy the varnishes ready made, and then proceed as follows :—

Taking equal parts of the best, clearest, and hardest amber-varnish and copal-varnish, mix them and heat until all the turpentine has disappeared. This will require a temperature of 100° to 150° R. As soon as all the turpentine has evaporated, remove the dish from the flame, allow it to cool somewhat, and then add oil of lavender to the liquid in the proportion of ½ to 1; mix well, and allow the entire mass to cool thoroughly. The process is terminated by adding from 20% to 40% of artificial cinnabar (eosin with cinnabar), which should be very carefully and thoroughly rubbed in. The best method for rubbing in the cinnabar is that employed in the preparation of fine oil-paints. Should the cement when finished be too thick for use, as much oil of lavender as will give the required fluidity may be added. The component parts and their proportions would then be as follows :—

Amber, - - - -	25 parts
Copal, - - - -	25 "
Linseed-oil varnish, - -	50 "
Oil of lavender, - -	50-60 "
Artificial cinnabar, - -	40-60 "

Dr. Heydenreich continues his article by describing the manner in which the cement should be applied, but as his method is the same as that employed in the use of Canada balsam and other cover-glass cements, and, consequently, familiar to all microscopists, I have not thought it necessary to make a note of it. I will, however, state that he advises, in order to secure a perfect mount, that a second ring be made after the first or second week from the time of mounting ; and a third, after the first or second month ; each additional ring to be slightly wider than the preceding one.

A SIMPLE AND INEXPENSIVE FORM OF BLACK-GROUND ILLUMINATOR.

BY PROF. ALFRED M. MAYER, OF THE STEVENS INSTITUTE OF TECHNOLOGY.

(*Read Jan.* 15*th*, 1886.)

This is a simple and inexpensive form of black-ground illuminator, devised for the study of aquatic life with low-power objectives of angular apertures up to 50° or 60°. For this purpose it works admirably, showing aquatic organisms as brilliant objects on a black ground, so that they are instantly detected among the more opaque particles of ooze in which they are generally found ; thus saving much time in such studies.

The illuminator shows these objects in their true colors ; for the pencil of illuminating rays, when properly adjusted, is sensibly colorless. The interior structure of rhizopods, infusoria, rotifers, worms, &c., is brought out in a manner which is very striking.

An angular aperture far exceeding that of the objective is not, in my opinion, desirable. This opinion is based on experiments with other dark-ground illuminators which give these large angles to the emergent pencil. With these we do not see so well the interior structure of translucent bodies—probably by reason of the interior reflections produced on rays falling at angles of too great incidence (when referred to the axis of the lens) on the boundaries of those portions of the organism which have different refractive indices. It is my opinion that, if the rays enter the objective at the smallest angle required for a black-ground, the interior structure of these bodies is shown in the best manner. Objects exhibited by this illuminator show no glow around their borders. A glow is often seen when other illuminators are used, and interferes much with good definition of the margins of objects.

The light which was used in my illuminator is obtained by placing a hollow lens, of the diameter of about five inches, between the flame of a student's-lamp and the plane mirror of the microscope. The flame of the lamp is diaphragmed down to a square opening which embraces the brightest part of the flame. The hollow lens contains a dilute solution of ammonio-sulphate of copper, prepared as follows : The lens is nearly filled with distilled water, and then a strong solution of the ammonio-sulphate of copper is added till a turquoise color is obtained. The solution is now cloudy from a partial precipitation of the hydrated oxide of copper. Ammonia is now added until the precipitate is just redissolved and the solution is free from any tint of green. The depth of color of the fluid in the lens has to be adjusted by trial, so that the blue of the lens shall just balance the orange of the flame. Then a soft, white light appears in the field. This intense whiteness, like alabaster, is very apparent in the dry mounts of shells of Difflugiæ, and frustules of Arachnoidisci, exhibited before the Society.

The plane mirrors, as generally made, of nearly all microscopes, except those of the grand-models, are too small in the front-and-rear diameter to illuminate the lower lens of dark-ground illuminators. I obviate this defect by cutting an ellipse out of a piece of plane mirror, and attaching this to the frame of any plane mirror by means of four small pieces of cork cemented to the back of the elliptical mirror. These pieces of cork fit outside of the circular brass frame of the ordinary plane mirror. The ellipse of the plane mirror has a minor axis a little larger than the diameter of the lower lens of the illuminator. The major axis is so long that when the mirror is inclined as much as it will ever need to be, to the axis of the microscope, the whole of the surface of the lower lens of the illuminator is covered by reflected light. The shorter axis of the elliptical mirror which I use is 1¾ inches, the longer axis is 2½ inches.

The optical combination forming this illuminator is as follows :—

There are three plano-convex lenses in contact with one another. These may be designated *A*, *B*, and *C*, in their order from below upward.

A is a plano-convex lens with its plane side facing the mirror. The radius of its curvature is 2¼ inches. Its thickness through its axis is $\frac{175}{1000}$ths of an inch. *B* is a plano-convex, with its convex side down. Its radius is 1 inch. Its thickness is $\frac{4}{10}$ths of an inch. *C* is a plano-convex, of the same radius and thickness as *B*. Its convex side is down.

On *B* is cemented a stop, formed of a piece of paper blackened with lamp-black in shellac. The diameter of the central stop is $\frac{71}{100}$ths of an inch. The width of the annular opening around the stop is $\frac{1}{10}$th of an inch.

Each of the lenses in the experimental form of the illuminator exhibited has a diameter of 1½ inches. It is evident that this diameter may be lessened in the lenses *B* and *C*, so that the combination when mounted will have the form of the frustum of a cone. With this form, the combination could enter the aperture in the majority of microscope stages, and its upper lens be brought even in contact with the under side of a slide.

The mean angle of the emergent rays at the upper lens, *C*, is 69½°.

The mean diameter of the annular opening of the stop is calculated in reference to the curvatures of the lenses, so that the central rays issuing from this stop fall normally on the convex surface of the lens *C*, and thus traverse it without refraction. This also tends to correct the chromatic dispersion of the pencil of rays emerging from *B*, whose boundaries of red and blue fall in directions inclined towards the normal of the lens *C*, on opposite sides of this normal.

This combination is not patented, and is at the service of all opticians and microscopists.

VITALITY OF THE LARVÆ OF THE NUT-WEEVIL.

BY F. W. LEGGETT.

(*Read Jan.* 15*th*, 1886.)

In preparing spiracles for mounting, I have made considerable use of those furnished by the nut-weevil (*Balaninus nucum*), a plentiful supply of which I found, much to the disgust of my family, in some hickory nuts on our table. It is not appetizing, I must acknowledge, to find one of these grubs ensconced within a morsel of fruit which you are about to convey to your mouth, and very few people are educated up to the point of gazing with enjoyment on its white, squirming body ; yet its whole life-history is interesting—a fact too well known to need repetition. I knew that, shut up within its air-tight hickory-house, its consumption of air must be infinitesimal, but I was not prepared to discover that it could live on air "bottled for private use," or upon that separated from liquids during days of complete immersion therein. In the course of dissecting a dozen, perhaps, of the larvæ, I found that, although apparently dead, they were not so in fact. They were cleverly performing the part of feigning death, or were indulging in a siesta, following a hearty meal of hickory-nut stolen from the tyrant, man. Exposure to the air for a short time revivified them.

Desiring to bleach a larva without destroying any of its softer parts, I placed one in a six-inch test-tube, filled to within one-half inch of its capacity, with peroxide of hydrogen, and here follows the result, as copied from memoranda made by me at the time: Put larva in test-tube at 7 P. M., Jan. 7th. Took it out at 5 P. M., Jan. 8th. Cut off a part of the side of the larva and mounted the piece cut off. At 7, the same evening, the creature was very lively. Placed it on a slide and looked at it through the microscope. The creature continued very lively the whole evening, although the moisture from the wounded part dried, and fastened the larva firmly to the slide. Jan. 9th, 7:45 A. M., the creature was still alive, although the posterior end near the wound continued to be hard and dry. On Jan. 10th, at 2 P. M., I placed another larva of the nut-weevil in the same test-tube with the same peroxide of hydrogen. Like the former one, it immediately sank to the bottom, where it remained until Jan. 14th, at 7 P. M., when I removed it to a glass cup and laid it on its side. Into this cup I poured about twenty drops of water. On Jan. 15th, at 8.30 A. M., I found the creature expanding and contracting itself. Thinking that this motion might be an optical delusion on my part, I showed it to two members of my family. Both saw the movement distinctly, and further, when I touched the creature with a needle, saw it raise its head in an unmistakably living manner. On Jan. 16th this larva was living and active. One specimen I mounted in Deane's mixture, taking it for that purpose directly from the test-tube where it had been immersed in the peroxide of hydrogen, thus giving it no chance to recover from its swoon by exposure to the air, if, like its fellows, it had swooned under the effects of immersion. For aught I know to the contrary, it may be alive on the slide at this moment.

PROCEEDINGS.

MEETING OF JANUARY 1ST, 1886.

The President, Mr. C. Van Brunt, in the chair.

Seventeen persons present.

The report of the committee appointed at the last meeting to nominate officers for the year 1886, was accepted and adopted, and the committee was discharged.

The hour for opening the polls for the annual election of officers having arrived, the President appointed Mr. Shultz, Mr. Warnock, and Mr. Wales, tellers to receive and count the ballots, and declared the polls open.

Mr. De Witt called the attention of the members to certain provisions in the Constitution and By-laws, suggested alterations, and, on motion, a committee was appointed to consider the advisability of amending and revising the same, with power to recommend such changes as they might deem proper; which committee consisted of Mr. De Witt, Mr. Mead, and Mr. Wall.

ELECTION OF OFFICERS.

The President announced the closing of the polls, and the following was declared to be the result of the balloting :—

For President, J. L. ZABRISKIE.

For Vice-President, P. H. DUDLEY.

For Recording Secretary, M. M. LE BRUN.

For Corresponding Secretary, B. BRAMAN.

For Treasurer, C. S. SHULTZ.

For Librarian, W. G. DE WITT.

For Auditors, {
E. C. BOGERT,
F. W. DEVOE,
W. R. MITCHELL.

MEETING OF JANUARY 15TH.—THE ANNUAL MEETING.

The President, Mr. C. Van Brunt, in the chair.

Twenty-eight persons present.

REPORT OF THE PRESIDENT, MR. C. VAN BRUNT, ON THE STATE OF THE SOCIETY.

The President said : " While I acknowledge that the gain in membership during the past year, and the satisfactory condition of our treasury, indicate continued prosperity for the society, I cannot help saying that, in my opinion, a more important indication of such prosperity is the unmistakably growing interest of the members in our proceedings, as shown by their full attendance, by their frequent contributions of valuable information to the Society, and by the readiness of so many of them to discuss whatever questions come before it.

"Something like this I said to you at the Annual Meeting of 1885, but I am pleased to add, that I have greater justification for the remarks now, than I had then.

"One feature of our gatherings I have observed, and with satisfaction,—the social element which pervades them, caused mainly by the presence of so many visitors of the gentler sex, members of our families, or our friends. I think that this feature adds to the attractiveness of our meetings ; indeed, I think the attendance of visitors of both sexes should be encouraged.

" From the Minutes, I have prepared a concise statement of the more important subjects which have occupied our time at the meetings of the past year, which statement is as follows :—

1. Feb. 20th.—The Life of an Oyster. By PROF. SAMUEL LOCKWOOD, Ph.D.
2. Mar. 6th.—Cell-structure of *Pinus Strobus*. By P. H. DUDLEY.
3. Visual Field of Worker Honey-Bee's Ocelli. By the Rev. J. L. ZABRISKIE.
4. Mar. 20th.—A Caterpillar Fungus from New Zealand, and Some Related Species of the United States; illustrated. By the Rev. J. L. ZABRISKIE.
5. Apr. 3d.—The Proper Care and Use of Microscope Objectives. By WILLIAM WALES.

6. Apr. 17th.—Sponges. By H. J. RICE.
7. May 1st.—Exhibition and Description of two small Dynamo-Electrical Machines used for Microscopical Illumination. By G. F. KUNZ.
8. May 15th.—"The Sealed Flasks of Crystal" (Inclusions in crystals). By A. A. JULIEN.
9. June 5th.—On Certain So-Called Prodigies. By C. F. COX. Chapman's Mould for Making Microscopical Cells. By E. B. GROVE.
10. Nov. 6th.—A Minute Phosphorescent Organism from the Surf on the Coast of New Jersey. By A. A. JULIEN.
11. Dec. 4th.—Electric Light for Use with the Microscope. By E. A. SCHULTZE.
12. Dec. 18th.—*Protococcus viridis*; with Illustrations. By P. H. DUDLEY and E. B. SOUTHWICK. A New Mounting Medium, by H. L. Smith. Read by the President, C. VAN BRUNT.

"A wide publicity has of late been given to our proceedings, through the agency of the Journal of our Society, which will, I think, ultimately result in much benefit to us.

"The average attendance during the past year was: members 20, visitors 15."

SUMMARY OF THE REPORT OF THE TREASURER,
MR. M. M. LE BRUN.

Balance, Jan. 16th, 1885, - - -	$ 25.94	
Receipts, to Jan. 16th, 1886, - - -	312.50	$338.44
Disbursements, to Jan. 16th, 1886, -		215.75
Balance, Jan. 16th, 1886, - - -		$122.69

SUMMARY OF THE REPORT OF THE LIBRARIAN,
MR. W. G. DE WITT.

Publications received during the year ending Jan. 16th, 1886,— - - -		
Foreign, - - -	90	
Domestic, - - -	230	
Total, - - -		320

the pages of which aggregated over 25,000.

OBJECTS EXHIBITED.

1. Diatoms mounted in Prof. H. L. Smith's new Medium: by C. VAN BRUNT.

2. Sections of Echinus Spines (*Diadema setacea*): by J. D. HYATT.

3. Dichroism of certain New-York Micas: by J. D. HYATT.

4. Section of Lava from Nevada: by J. D. HYATT.

5. Amber, enclosing various Diptera: by WM. G. DE WITT.

6. Achenia of *Cyperus flavescens*, L., and *C. diandrus*, Torr.: by N. L. BRITTON.

7. *Sarcoptes scabiei* (Itch Mite), male and female: by C. S. SHULTZ.

8. Mycelium, Pileus, and Spores of *Lentinus lepideus*, Fries: by P. H. DUDLEY.

THE ITCH MITE.

Mr. Chas. S. Shultz exhibited a slide containing specimens of one of the Acari, *Sarcoptes scabiei* (Itch Mite), the cause of Scabies or "Itch," a parasitic disease of the human skin, and said:—

"This slide contains a mature male and female, an undeveloped young mite, and an egg. Few only of the younger people in this country have seen cases of Itch, or the mite which causes the disease, although not many years ago the Itch was quite common here. At present, it is prevalent among the peasantry of Central Europe, especially in portions of the Austrian provinces of Hungary, Bohemia, &c., where the people saturate their under-clothing and mittens with grease to protect themselves from the cold, and retain these garments unchanged upon their persons for months. On the warmer parts of the body, especially the arm pits, bends of the elbows, and between the roots of the fingers, the female mite, which is the chief cause of the disease, burrows into the flesh, there depositing her eggs, and, while awaiting their hatching, cuts into the flesh, causing irritating pustules to form upon its surface. When the eggs are hatched, the young Acari rapidly develop, and leave the breeding place, the females starting new burrows or galleries, the males hiding quietly under the cuticle, causing no irritation. The male mite is but one-half the size of the female. The mature *Sarcoptes* has eight legs. The young begin with six only, but develop the other two after commencing their burrowing. 'The four anterior legs are provided with sucking disks, and with bristles armed at their extremities with minute claws; but the posterior feet have no sucking disks. The mouth has a double upper and lower lip, between which play the jaws armed with teeth, moving over each other like the blades of scissors, and resembling the claws of a lobster.' Centuries ago, Scabies or Itch was ascribed to a parasite, but not until the modern microscope was used in the study of such subjects, could a sight be obtained of the creature itself and its wonderful structure."

ACHENIA OF CYPERUS FLAVESCENS, L., AND C. DIANDRUS, TORREY.

Dr. N. L. Britton called attention to the difference in surface markings of the achenia of these two sedges. In *C. flavescens* the superficial cells on the achenia are oblong, about four times as long as broad. In *C. diandrus*, and in our other native species of the subgenus *Pycreus*, these are quadrate, and much larger than in *C. flavescens*, which may thus be distinguished from the others. Mr. C. B. Clarke, in a monograph on the Indian species of *Cyperus* (*Jour. Linn. Soc.* (Botany), XXI.), has used these features to advantage in classifying the species. Dr. Britton's investigations confirm Mr. Clarke's diagnosis in this respect.

FUNGI WHICH CAUSE DECAY IN TIMBER.

P. H. Dudley: "The fungus *Lentinus lepideus*, Fr., an Agaric, is the one I have found to be very destructive to railway sleepers, bridge-timbers, and planks, made of yellow, or Georgia pine (*Pinus palustris*, Mill.). It has a whitish, delicate mycelium, its hyphæ being 1 to 1.5μ in diameter, and when attacking the wood at its ends, is able, in many cases, to separate the annual rings. It secretes fluids possessing acid reactions, readily softens the thin-walled tracheides, causing their decomposition, and produces an abundance of crystals of the form of oxalate, and sometimes of phosphate, of lime. In some cases, carbonate of lime has also been found. The mycelium once started, secretes enough moisture for its own nourishment and development, and rapidly multiplies. Decomposition of the wood, the so-called 'dry-rot,'—which, contrary to the general opinion, never takes place in the absence of moisture—as rapidly ensues, unless the moisture be dried by external agencies. In railway sleepers, as soon as the thin-walled tracheides are softened by the action of this fungus, larvæ, from $\frac{1}{16}$th to $\frac{1}{8}$th of an inch long, perforate and consume them, leaving the thick-walled, harder cells in the condition of a series of shells, rendering the sleeper useless in less time than would the action of the fungus alone. When the fungus attacks the sleeper on its sides or bottom, the mycelium spreads over it in a beautiful arborescent manner, and requires a longer time to penetrate the wood than when the attack is made at the end of the sleeper. As the *Lentinus lepideus* fruits under very favorable conditions only, it is rarely found on railway sleepers. It can be identified by certain characteristics which it possesses. Associated with it, are found in great abundance various species of *Schizomycetes*, many of them occupying cells adjacent to those containing the mycelium of the *Lentinus lepideus.* The fruit spores of the last named are white, abundant, $3.5\mu \times 8\mu$ in size, curved, one end apiculate. The annual loss to consumers of yellow pine, caused by this fungus, amounts to hundreds of thousands of dollars."

PUBLICATIONS RECEIVED.

The Naturalist's World : Vol. II., No. 24 (December, 1885) ; pp. 16. Vol. III., No. 25 (January, 1886) ; pp. 20.

Johns Hopkins University. Circulars : Vol. V., No. 45 (December, 1885) ; pp. 12.

National Druggist : Vol. VIII., No. 1 (January 1st, 1886) ; pp. 16. No. 2 (January 8th) ; pp. 16. No. 3 (January 15th) ; pp. 16. No. 4 (January 22d); pp. 16.

Brooklyn Entomological Society. Entomologica Americana : Vol. I., No. 10 (January, 1886) ; pp. 20.

Indiana Medical Journal : Vol. IV., No. 6 (December, 1885) ; pp. 24.

Monatsblätter des Wissenschaftlichen Club in Wien : Vol. VII., No 3 (December 15th, 1885) ; pp. 10. No. 4 (January 15th, 1886) ; pp. 12. Ausserordenlliche Beilage : No. 1 ; pp. 41.

Transactions of the New-York Academy of Sciences : Vol. III. (1883–4) ; pp. 168. Vol. V., No. 1 (October, 1885) ; pp. 24. No. 2 (November); pp. 48.

Proceedings of the Natural Science Association, of Staten Island : December 12th, 1885; p. 1. Extra, No. 4 ; p. 1. January 9th, 1886 ; pp. 2.

The Correspondence University Journal : Vol. III., No. 3 (January, 1886) ; pp. 16.

The Electrician and Electrical Engineer : Vol. V., No. 49 (January, 1886) ; pp. 40.

Anthony's Photographic Bulletin : Vol. XVII., No. 1 (January 9th, 1886) ; pp. 32. No. 2 (January 23d) ; pp. 32.

The Journal of the Cincinnatti Society of Natural History : Vol. III , No. 4 (January, 1886) ; pp. 58.

The Journal of Mycology : Vol. II., No. 1 (January, 1886) ; pp. 12.

The Microscope : Vol. VI., No. 1 (January, 1886) ; pp. 24.

Drugs and Medicines of North America : Vol. I., No. 8 (December, 1885) ; pp. 32.

Bulletin of the United States National Museum, No. 23, 1885 ; pp. 59+278. From Isaac Lea, LL. D.

The Journal of Microscopy and Natural Science : Vol. V., Pt. 17 (January, 1886) ; pp. 68.

Massachusetts Horticultural Society : Schedule of Prizes offered for the year 1886 ; pp. 40.

The American Monthly Microscopical Journal : Vol. VII., No. 1 (January, 1886) ; pp. 20.

Vick's Illustrated Monthly Magazine, and Floral Guide : January, 1886 ; pp. 32+128.

The Botanical Gazette : Vol. XI., No. 1 (January, 1886) ; pp. 24.

Bulletin of the Torrey Botanical Club : Vol. XII., No. 12 (December, 1885) ; pp. 12.

Bulletin de la Société Belge de Microscopie : Vol. XII., No. 2 (November 30th, 1885); pp. 7.

INDEX TO ARTICLES OF INTEREST TO MICROSCOPISTS WHICH HAVE RECENTLY APPEARED IN OTHER JOURNALS.

Algæ, Fresh-Water : Francis Wolle.
Bul. Torr. Bot. Club, XII. (1885), pp. 125–9 (15 figs.).

Antheridien und Spermatozoiden der heterosporen Lycopodiaceen : Wl. Belajeff.
Bot. Zeitung, XLIII. (1885), pp. 794–819 (60 figs.).

Astigmatism and its Relation to the Use of Optical Instruments : Ernst Gundlach.
The Microscope, VI. (1886), pp. 1–4.

Blood, Human, A Study of : C. H. Stowell.
The Microscope, V. (1885), pp. 265–9 (3 figs.).

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JOURNAL
OF THE
NEW-YORK MICROSCOPICAL SOCIETY.

VOL. II. MARCH, 1886. No. 3.

THE MICROBES OF PANARY FERMENTATION.[1]

The question of panification is one of such importance that it might at first sight be supposed that it would have been one of the first to be solved by contemporary science. Such, however, has not at all been the case, for in recent years the most contradictory opinions upon the chemistry of bread have been emitted by distinguished scientists. In order to ascertain what phenomena accompany panary fermentation, let us rapidly pass in review the various categories of bread. In the first place, we have unleavened bread, the use of which is pretty much restricted to the ceremonies of various religions. At first sight, it would seem that we had nothing to do here with any ferment, but, as a matter of fact, there is no such thing as unleavened bread, and, supposing that such a thing really existed, we should here again have some very complex phenomena to submit to scientific analysis.

In bread with leaven, we see an action analogous to that of brewer's yeast upon an infusion of malt—to that of the substances commonly known as "mother of wine" and "mother of vinegar." What is the nature of leaven, and what does it do in dough ? In order to answer these questions, it will perhaps be easier to reason by analogy. The ferment contained in leaven is comparable to brewer's yeast, which is a microscopic plant—a *Saccharomyces*—that possesses the remarkable property of converting the sugar of must into alcohol and carbonic acid. Brewer's yeast and mother of wine, then, modify the composition of saccharine must and determine its yield of alcohol. But it is not yeasts only that act upon organic liquids, for in mother of vinegar we have narrow cells, of varying length, called bacteria. The existence of these organisms in leaven and dough had been pointed out several times without any one ever dreaming of according them any very important role ; but such was not the case with quite a small form found in leaven by Mr. Engel, who had no hesitation in attributing to it the phenomenon of panary fermentation. This was in 1872. At this epoch there was very little talk of the chemical action produced by bacteria, and a somewhat peculiar circumstance was adduced in favor of yeasts. It appears that for many centuries it has been customary in some places to add a little brewer's yeast to dough, and, at present, bread made in this manner is extensively eaten in those countries where beer is the principal beverage. What role must be attributed to brewer's yeast in the preparation of bread ? Have we here an alcoholic ferment as in the brewer's mash-tub ? This is a very delicate question, and one which would require an excursion into the domains of chemistry for an answer.

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[1] Condensed from a paper by Emile Laurent, in the *Bulletin de la Société Royale de Botanique de Belgique.*

Let us now pass to something that is more directly connected with the subject of this paper.

Bacillus panificans.—Let us make some dough with any sample of flour whatever, and expose it for a few hours to a temperature of 35°. With an amplification of from 400 to 500 diameters, the microscope will show us the presence of starch and gluten, and, here and there, of small, slender rods, which are six times their width in length, and which are movable in the water in which the preparation was made. We have before us a bacterium of the type *Bacillus.* In order to facilitate the distinction of the micro-organisms in dough, it is well to employ a drop of a solution of iodine, or to color the bacilli by means of an aqueous solution of methyl violet or of fuchsine.

These bacilli are met with in leaven and dough of very diverse origin, and no sample of either has been examined which does not contain them. Some persons, while admitting that these organisms are dispersed over the entire earth, may nevertheless deny their specific unity ; but Dr. Koch's studies have fortunately furnished us with a sufficiently sure means of characterizing any species of bacterium. For this purpose, a bit of dough is intimately mixed with a little water freed from germs by the Chamberland filter, or by repeated boiling. A drop of the liquid is added to a tube of gelatinized and peptonized bouillon, and the contents are then carefully poured upon a strip of glass, or upon a flattish watch-crystal that has been sterilized at a high temperature. At the end of the second day, or beginning of the third, there will appear upon the layer of gelatine some whitish spots, which, when examined under the microscope, will be found to be bacilli. Each rod has produced offshoots, and its progeny occupies a particular space that forms what is called a "colony." Every colony of the same species has an aspect that is peculiar to it, and, if several species be found in flour, we shall see several sorts of colonies. But there is one form of colony that predominates in a truly astonishing proportion. By its perfectly circular form, by its color, and by its mode of development in cultures upon gelatine, it may be recognized in a mixture of the bacteria of putrefaction. The rods of this species are found in bread after it has been baked, and more than 500,000 of them have been seen in a gramme of leavened bread—say 250,000,000 to the pound. These figures may cause those to shudder who have a horror of microbes; yet these bacilli are not only harmless, but are even powerful aids to us in the digestion of food.

Let us examine their mode of life in dough. We already know that, under the action of water and soluble ferments, there is an increase of the peptones and sugars in the dough. The germs of the *Bacillus* disseminated in flour soon multiply upon contact with water and soluble aliments. This species, moreover, has the property of depriving dough of a portion of its gluten, and of reducing the latter to soluble substances. In return, it improves the quality of bread. It lives and breathes, and consequently produces carbonic acid, which forms cavities in consequence of the elasticity of the gluten. It is due to this action that bread is rendered lighter and more agreeable to eat. Aside from this important function, the bread-bacillus brings about quite complicated actions in the dough. It will suffice to mention the production of acetic, butyric and lactic acids, which give bread a very pronounced acidity. There is no longer any possible doubt of it—the bacillus under consideration is the bacterium of panary fermentation, and so the name *Bacillus panificans* has been proposed for it.

And now as to the physiology of the organism: It is easily cultivated in Koch's nutritive gelatine, acid or slightly alkaline. In acid gelatine it produces carbonic acid, but in alkaline no bubbles are formed, because a combination with the base occurs. It begins to develop at a temperature of about 6°, and the development continues up to 45°. At first, we observe some very short rods, but later on, after the liquid has become impoverished, we find elongated bacilli only. When the temperature is sufficient, these form a superficial veil wherein we often find very long filaments. The spores make their appearance at the centre of each articulation soon afterwards, and quickly drop off. They are easily distinguished in a preparation, since they are not colored by aniline. These spores are killed only at a temperature of 100°, prolonged for at least ten minutes. The sporeless rods, also, withstand very high temperatures, and it is certain that they survive at a depth of more than 7 or 8 millimetres in the bread, after the latter has been baked.

When we eat a little bread, then, we swallow myriads of living bacilli. These are not destroyed in the human stomach, but, on the contrary, find in the alimentary canal an abundance of albuminoid and starchy substances for their nourishment. Owing to their being adapted to both acid and alkaline media, and to their property of living with or without air, they must contribute towards digestion in man's alimentary canal.

It is this same species of bacillus that, with a few others, works in night-soil, and renders organic residua fit for the nourishment of the plants of our fields and gardens.

A few words as to bread made with yeast: As a matter of fact, there is no bread free from bacteria, since germs always exist in the flour used. For the same reason, we never have any bread made exclusively with yeast. In Belgian bread, fermentation is induced by *Saccharomyces cerevisiæ*. The phenomenon is the same as with the bacillus, save that it proceeds much more rapidly. Thus, it takes six or seven hours to prepare bread with leaven, while with yeast we in two hours obtain a dough that is fit for baking. Nevertheless, we may ask whether this substitution of the *Saccharomyces* for the *Bacillus* can be done without danger, and whether the one is just as well adapted as the other for panary fermentation. Aside from the phenomenon of disengagement of carbonic acid, common to all living beings, we have to consider the physiological action of the *Saccharomyces* as compared with that of the *Bacillus.* The actions are different, as we may easily see by comparing the taste of bread made with yeast with that of bread made with leaven. Such difference is doubtless caused by products of fermentation of variable nature and number.

It is now possible to give a brief resumé of the principal phenomena that occur during the preparation of bread. Through kneading, the dough acquires a homogeneous composition in every part. Upon contact with water and the soluble ferments derived from the triturated cells, a portion of the starch and albuminoids becomes more easily assimilable for living beings. The organic ferments, *Saccharomyces* or *Bacillus*, mixed with the dough during kneading, feed on the substances that have become soluble, and produce carbonic acid gas. This latter accumulates in the cavities of the gluten, and thus, through the intervention of these organisms, the bread acquires lightness and savor. Baking finishes these modifications by altering the structure of the starch grains that have remained intact, and by increasing the size of the cavities through the expansion of the gas by heat. So the size of the loaf greatly increases in the oven. The external surface of the dough undergoes completer transformations than the central part does, in consequence of the higher temperature to which it is submitted. The starch is converted into dextrine, especially if there be a little steam in the oven, or the surface of the loaf be moistened with water ; and thus results the beautiful, golden varnish so much liked by consumers.

This study of *Bacillus panificans* will permit us to explain the cause of

Ropiness in Bread.—During the warmest months, from June to September, it often happens that bread prepared in country houses undergoes transformations of a peculiar nature. Two or three days after being baked, it emits a putrid odor, and, when eaten, has a saccharine and not unpleasant taste. In a short time, the odor becomes stronger, and recalls that of albuminoid substances in a state of decomposition, and a finger inserted in the loaf shows the interior to be of a ropy consistency. This state of the bread is caused by the *Bacillus panificans*, when there is lack of sufficient acidity. The trouble may be prevented by the addition of a sufficient quantity of some organic acid to the dough.

PROCEEDINGS.

Meeting of February 5th, 1886.

The President, Mr. C. Van Brunt, in the chair.

Thirty-four persons present.

The President spoke as follows :—

"This meeting, being the first after the Annual Meeting, is known, under our By-laws, as the Annual Reception. As it is incumbent on the newly elected officers to assume their duties at the Annual Reception, I take pleasure in resigning the chair to Mr. Zabriskie, our President for 1886."

Mr. Zabriskie, on taking the chair, said :—

"I thank you, gentlemen of the Society, for the honor you have done me in selecting me to preside over your deliberations. I am less confident of my ability to discharge the duties appertaining to the office of President in a manner which shall prove satisfactory to you, than I am of my desire to do so.

"I would like to be of use to you, I would like to learn much from you ; and while I cannot but acknowledge that you exhibit considerable interest in the work and welfare of the Society, I would like, if I could do so, to say something which will not only keep that interest alive, but will stimulate it to increased activity.

"The reflection that the field covered by the labors of such a Society as ours is so very large that no one has time, or means, or ability to work in every part of it, is encouragement for even modest efforts in microscopical investigation. In the verification of phenomena observed by other persons, facts unnoticed before are often met with, sometimes unimportant, sometimes significant, sometimes completely altering the conclusions of our predecessors.

"Such reflections are incentives to the microscopical worker of every class and rank ; and if, induced by a desire to see, to learn, to know, even the least experienced undertake research, how well provided he is with help ! In no part of the world of science has the explorer trustier maps and charts for his guidance than in the wonderfully fascinating portion, entrance to which must be made through the microscope.

"If there be persons who only pursue their studies under the stimulus of possible gain or good to themselves or to their fellows, surely, microscopical work offers to even such opportunities innumerable, embracing, as it does, almost every conceivable subject of a physical nature which can possibly interest man—from the etiology of disease to the constituents of the spheres.

"Let us, then, continue our investigations with additional energy. Let us bring their results here. In the hope that our meetings during the year upon which we now enter will be signalized by interesting and valuable work, I assume the trusts which you have imposed upon me."

The following objects were exhibited :—

1. Globules of Copper ejected from a Siberian Volcano : by H. W. CALEF.

2. *Polyporus pinicola*, Fx., showing reactions of Phosphoric Acid : by P. H. DUDLEY.

3. Arranged Diatoms (one hundred and three species from the Pernambuco deposit); mounted by C. H. Kain, Camden, N. J.: by E. A. SCHULTZE.

4. Jasperized Wood from Arizona, showing fibrous structure : by L. SCHÖNEY.

5. *Rubus occidentalis ;* transverse section, shown by polarized light : by W. G. DE WITT.

6. Shell of *Difflugia corona ;* shown by polarized light: by W. G. DE WITT.

7. Crystals of Potassium Carbonate, shown by polarized light: by B. BRAMAN.

8. *Volvox globator :* by A. D. BALEN.

GEOLOGICAL PERIOD OF THE JASPERIZED WOOD FROM ARIZONA.

Dr. L. Schöney said : "I obtained my specimen of jasperized wood from the Jasperized Wood Company. It was mounted in Canada balsam by Mr. Lowden, of Poughkeepsie. The specimen shows, in its transparent spots, the characteristic markings of *Araucaria*—most probably of the species *Cunninghami*—with the dots in alternate rows. This group of trees is represented in the Jurassic period (the Wealden epoch), on the upper horizon of it, or in the lower Triassic. The living representatives at the present time are confined to the southern hemisphere, to Brazil, Chili, but especially to Australia, and Norfolk-Island. *Araucarias* are found in the Carboniferous strata, closely allied to the specimen present, but, as with it are found other fossils, including sharks' teeth, which indicate a period later than the Carboniferous, the horizon of our specimen is more probably Jurassic or Triassic. Additional characteristic fossils of the place from which this specimen was taken must be found and determined, to settle the question definitely."

VOLVOX GLOBATOR KEPT ALIVE FOR THREE MONTHS.

Mr. A. D. Balen: "I have brought some specimens of *Volvox globator* which are interesting from the fact that they were taken from a bottle which has contained living organisms like these for three months, dating back from to-night, February 5th. During the last ten years I have made numerous attempts to keep these plants alive, but, except in the present instance, have found that they usually die out in about two or three weeks. Running through the southern portion of Plainfield is Cedar brook, a part of which, between Park and Prospect Avenues, passes through low ground, swampy in wet seasons, but sometimes quite dry. About half way between the avenues, there are several depressions which form little ponds. From these I have for several years taken plants and animals for microscopical examination, among them *Volvox*, which at times was very abundant. On November 5th, 1885, from the contents of each of three of those ponds I filled a four ounce quinine bottle. I took the bottles home, and on examination found a large quantity of *Volvox* in one, but only a small quantity in the others. All were in the ordinary sterile condition. After a few days none were visible in two of the bottles, but in the remaining bottle they had increased in number. This increase continued until a fire was made in the stove in my room, January 13th, 1886, when the *Volvox* lost color and began to disappear, owing, I thought, to the effects of coal-gas from the stove. I moved this third bottle to a window further from the stove than it had been placed, and, on the 17th, filled it with water from a well to replace what had evaporated. From that time the plants again increased in number, but decreased, I think, in size. The bottle has hung constantly in front of a window where the sun shone in during a part of the day."

MEETING OF FEBRUARY 19TH, 1886.

The President, Mr. J. L. Zabriskie, in the chair.

Twenty-seven persons present.

The following objects were exhibited :—

1. Crystals of Vanadinite : by M. M. Le Brun.
2. Young Poduras, found on gills of Toad-Stool : by W. G. De Witt.
3. Fresh Crystals of Platino-Cyanide of Magnesium : by C. Van Brunt.
4. Seeds of *Anagallis arvensis*, *in situ* in pyxis : by B. Braman.
5. *Ribes nigrum ;* transverse section of stem, double stained : by Walter H. Mead.

Mr. P. H. Dudley exhibited a Thoma Microtome, and described the method of using the same.

Mr. H. L. Brevoort exhibited a compound microscope and accessories made by Dolland, of London, which had been in the possession of Mr. Brevoort's family since 1795.

The President exhibited a smaller microscope of simpler construction, also by Dolland, and as old as that shown by Mr. Brevoort.

Mr. W. G. De Witt said that the scales shown by him were from a young podura. They were found, he said, near Savannah, Georgia, on the gills of a toad-stool, in the month of April. He suggested that search for poduras be made in this vicinity during the months of May and June, which, in this latitude, correspond in temperature with April in Savannah.

Mr. Arthur G. Leonard was elected an active member.

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JOURNAL
OF THE
NEW-YORK MICROSCOPICAL SOCIETY.

VOL. II. APRIL, 1886. No. 4.

PHILOPTERUS CORVI.

BY PROF. SAMUEL LOCKWOOD, PH.D.

(*Read March 19th*, 1886.)

According to Dr. Packard, the great order Hemiptera, the defective-winged insects, takes in the *Cicada*, the *Notonecta*, or Water-Boatman, the *Aphidæ*, or leaf-vermin, and many other insects, including certain degenerate species which are entirely wingless, closing with the most degraded forms of the whole order,—the parasites which infest animals and which are known as lice proper. These vermin are embraced in two distinct families, one bearing the name of Pediculina, the other, Mallophaga. The former are genuine blood-suckers, being specially fitted for that business, having a sharp-edged tubular snout which can be thrust into the skin of the host and through which blood can thus be withdrawn. They have no jaws. They infest man and beast, and, strange to say, different species may infest the same animal, each species confining itself to its own especial part of the body. It is even claimed that the lice found on different races of men are specifically different.

The Mallophaga infest birds and mammals ; in other words, the feather-clad and the hair-clad animals. Even the porpoise of the sea is not permitted to be free from them. They devour the feathers and hairs upon which they dwell, and hence the great difference between their mouth-parts and those of the blood-suckers. The Mallophaga are masticators. They possess jaws by means of which they comminute their tough pabulum, namely, feathers and hairs, which consist almost entirely of keratose, or horn. They are numerous in species although the number of genera is comparatively small.

There used to be a doggerel proverb among sporting men,—

"The feathers and the hair
Make many a man swear."

It is well that verbal utterance is denied to the beasts and the birds. If it were not, surely the miseries inflicted on them by man and the Mallophaga would evoke maledictions enough to raise one's hair.

Of the several genera of these pests of the bird is one named *Philopterus*, a word which seems to mean a lover of the flying-race. Evidently, it must be by way of irony that this tormenting creature is set down as a lover of the birds! This parasite, the *Philopterus*, more accurately described, is a lover of feathers; and, like the expert house-wife, it recognizes and prefers "live feathers;" for immediately after the death of its host the *Philopterus* deserts its feathery home, both bed and board.

On the 30th day of January last, a crow just shot was brought to my house. It was infested with vermin, of which the slide exhibited this evening contains two specimens. They differ very much in size. The larger one I set down as *Philopterus Corvi.* I am not sure that the smaller one is of the same species. Besides that of size it has other differences, notably the curious development of hair on each side of its head, which is lacking in the larger one. A pedicelled egg behind the abdomen indicates that it is of the female sex; but, then, bearded ladies are not often found outside of "Dime Museums." The discrepancy of size is very marked, and generally, when this is so pronounced between two mature individual insects of the same species, the one of the lesser proportions is the male. However, one meets problems like this constantly, and in the pursuit of entomology the perplexed student is often compelled to admit, "It beats the boys!"

PROCEEDINGS.

ANNUAL RECEPTION OF 1886.

The Eighth Annual Reception of the Society was held at Lyric Hall on the evening of March 5th, 1886.

In several important features this reception differed from those which had preceded it. There was no address by the President, the annual address by that officer having been delivered at a previous meeting of the Society; hence, the entire evening was given up to the examination, by the guests, of the microscopic objects shown, and to the usual social interchanges which so markedly characterize these receptions. From the numerous objects offered for exhibition by the members, fifty-two only were selected by the managers. These occupied twelve substantial tables which were placed in the Auditorium. The great size of this room permitted the one thousand guests present to move about with comfort and to study at their convenience the objects shown by the thirty-three members who were exhibitors. The contiguous hall, in which were the musicians, contained ample seating room for such persons as from time to time left the tables, to be nearer the music, to rest, or to converse more at ease than they could in the exhibition hall.

The objects shown were as follows :—

1. *GREEN SAPPHIRE WITH CUNEIFORM INCLUSIONS.*
   Exhibited by G. F. KUNZ.
2. *GEM GRAVEL, FROM CEYLON.*
   Exhibited by G. F. KUNZ.
3. *SCALES OF THE SEA-ROBIN.*
   Exhibited by W. H. BATES, M. D.
4. *ROTIFER VULGARIS.*
   Exhibited by W. R. MITCHELL.
5. *TONGUE OF DOG.*
   Exhibited by EDWARD G. DAY.
6. *CLAW OF MOSQUITO.*
   Exhibited by EDWARD G. DAY.
7. *RECENT FRESH-WATER DIATOMS.*
   Exhibited by C. VAN BRUNT.

8. *A MICROSCOPIC ENGRAVING.*
Exhibited by C. VAN BRUNT.

9. *SPINNERET, OR SPINNING ORGAN OF THE SPIDER.*
Exhibited by C. VAN BRUNT.

10. *CRYSTALS OF HORSFORD'S ACID PHOSPHATES: SHOWN BY POLARIZED LIGHT.*
Exhibited by C. VAN BRUNT.

11. *CILIA OF THE OYSTER.*
Exhibited by F. W. DEVOE.

12. *YOUNG SALMON (just hatched).*
Exhibited by F. W. DEVOE.

13 *HUMAN BLOOD,*
Exhibited by F. W. DEVOE.

14. *FERN-LEAF GOLD CRYSTALS.*
Exhibited by G. S. WOOLMAN.

15. *PLATINO-CYANIDE OF MAGNESIUM.*
Exhibited by G. S. WOOLMAN.

16. *SEEDS OF ORTHOCARPUS PURPURASCENS.*
Exhibited by G. S. WOOLMAN.

17. *CRYSTALS OF STEEL IN A STEEL CASTING.*
Exhibited by P. H. DUDLEY.

18 *ETCHED SURFACE OF A STEEL CASTING.*
Exhibited by P. H. DUDLEY.

19 *DIAMOND-BEETLE.*
Exhibited by M. H. EISNER.

20. *EMBRYO CHICK (fourth day).*
Exhibited by M. H. EISNER.

21. *SPIRACLES.*
Exhibited by F. W. LEGGETT.

22. *CRYSTALS OF CINNABAR.*
Exhibited by J. A. CHAMBERS

23. *VOLCANIC GLASS, FROM DAKOTA.*
Exhibited by E. B. GROVE.

24. *BACILLUS TUBERCULOSIS.*
Exhibited by L. SCHÖNEY, M. D.

25. *ARRANGED DIATOMS.*
Exhibited by WILLIAM WALES

26. *MANGE INSECT (Dermatodectes (Sarcoptes) equi) FROM A HORSE.*
Exhibited by WILLIAM WALES.

27. *FOSSIL WOOD FROM ARIZONA, TRANSVERSE SECTION.*
Exhibited by M. M. LE BRUN.

28. *FOSSIL WOOD FROM ARIZONA, LONGITUDINAL RADIAL SECTION.*
    Exhibited by M. M. LE BRUN.
29. *POLYCYSTINA.*
    Exhibited by BENJAMIN BRAMAN.
30. *CIRCULATION OF BLOOD IN THE FROG.*
    Exhibited by J. L. WALL.
31. *LACINULARIA SOCIALIS.*
    Exhibited by W. E. DAMON.
32. *CIRCULATION OF BLOOD IN THE TAIL OF A FISH.*
    Exhibited by WALTER H. MEAD.
33. *ARRANGED GROUP—DIATOMS, SYNAPTA, AND CHIRODOTA.*
    Exhibited by C. S. SHULTZ.
34. *EGGS OF PARASITE.*
    Exhibited by C. S. SHULTZ.

35 and 36. *POND-LIFE.*
    Exhibited by A. D. BALEN.

37. *MULTIPLE IMAGES FORMED BY EYE OF COCKROACH.*
    Exhibited by J. D. HYATT.
38. *TROMBIDIUM, OR RED MITE.*
    Exhibited by the Rev. WM. HUCKEL.
39. *SECTION OF A FRAGMENT FROM THE OBELISK.*
    Exhibited by A. WOODWARD.
40. *DIATOMS.*
    Exhibited by E. A. SCHULTZE.
41. *SPICULES OF GORGONIA.*
    Exhibited by W. G. DEWITT.
42. *TRICHINA SPIRALIS IN HUMAN MUSCLE.*
    Exhibited by W. G DEWITT.
43. *IRIDESCENT COPPER PYRITES.*
    Exhibited by LUCIUS PITKIN.
44. *DIATOMS.*
    Exhibited by LUCIUS PITKIN.
45. *SECTIONS OF PINE-NEEDLES.*
    Exhibited by H. W. CALEF.
46. *HEAD OF CRANE-FLY.*
    Exhibited by F. COLLINGWOOD.
47. *YOUNG CATERPILLARS.*
    Exhibited by E. B. SOUTHWICK.
48. *JAWS OF LARVA OF APPLE-TREE BORER* (*S perda candida, Fabr.*).
    Exhibited by E. B. SOUTHWICK.

49. *A PIGEON-POST FILM.*
Exhibited by the Rev. J. L. Zabriskie.

50. *SECTION OF FELTED WOOLEN GOODS.*
Exhibited by H. L. Brevoort.

51. *INSECT SCALES.*
Exhibited by C. W. McAllister.

52. *ARRANGED DIATOMS.*
Exhibited by C. W. McAllister.

Meeting of March 19th, 1886.

The President, Mr. J. L. Zabriskie, in the chair.

Twenty-five persons present.

OBJECTS EXHIBITED.

1. Graphite Scale from No. 1 Cast Iron: by P. H. Dudley.

2. No. 2 Cast Iron, showing fine and coarse structure: by P. H. Dudley.

3. No. 3 Cast Iron, showing fine and coarse structure: by P. H. Dudley.

4. Vertical section of human Scalp; mounted by S. G. Shanks, M.D.: by A. G. Leonard.

5. Crow-Lice (*Philopterus Corvi*): by F. W. Devoe.

6. Eggs of *Chrysopa oculata*, Say, *in situ* on their long silken stalks: by E. B. Southwick.

7. Hymenopterous Insect of the genus *Torymus*, parasitic on the gall (*Rhodites bicolor*) on the Swamp Rose (*Rosa Carolina*, *L.*): by J. L. Zabriskie.

8. An Ant and one of its "cows" (*aphides*): by E. B. Southwick.

9. Jaws of Larva of Nut-Weevil: by F. W. Leggett.

STRUCTURE OF CAST IRON.

Mr. P. H. Dudley said: "I have under the microscope a scale from No. 1 cast iron.

"Among the several grades of cast iron are those known as No. 1, No. 2, No. 3, and No. 4; special names being given to other grades, as white, mottled, etc. The coarsest parts of cast iron in large castings are found in the centre of the castings, the apparent crystals being much larger there than in any other part. No. 1 cast iron contains graphite, that is, it contains about five *per cent.* of carbon, of which more than one-half is graphitic carbon. Before the metal congeals, this seems to partly crystallize, forming minute laminæ, which become the weak places in the larger pieces of cast iron.

"I have scales from railroad iron which are nearly one-eighth of an inch in thickness. When this iron breaks, the fracture does not pass through the solid portions, but follows the planes of these scales. A piece of No. 1 cast iron, three feet long and three inches by four inches thick, will break if these scales are in the metal. In No. 2 cast iron these scales are smaller. I have found in it one small fragment only, which perhaps consists of a single minute lamina, and was discovered lying between what appeared to be crystals.

"The scale under the first microscope is from No. 1 iron, and consists probably of four or five layers, although it is not more than $\frac{1}{2000}$th of an inch thick. Under the second microscope is a specimen of No. 2 iron, and under the third microscope is a specimen of No. 3 iron. In the No. 2 and No. 3 the outer portions of the specimens are of fine texture, but the central parts are almost as coarse as in No. 1, which is evidence of weakness of structure.

"These laminæ limit the size of castings. In the manufacture of ordnance the limit where size precludes strength is soon reached. Very large guns are in fact sometimes weaker than small ones.

"The graphite scale (under the first microscope) resembles very closely the graphite which comes from Ticonderoga. The piece of cast iron No. 2 (under the second microscope), although apparently finer than specimen No. 3 (under the third microscope), displays what appear to be crystals, also a layer-like structure, the plates of which extend in various directions. Between these plates cavities exist which make the iron comparatively porous."

CONCERNING STEEL RAILS,

Mr. Dudley, in answer to a question, remarked: "In steel the percentage of graphite is very small. Bessemer steel contains about $\frac{3}{10}$ths of one *per cent.* of carbon, of which a small proportion is sometimes graphitic carbon. Steel is not absolutely amorphous. Its crystals are, at present, supposed to be surrounded by carbide of iron. It is considered that, the softer the steel, the more rapidly it wears and the more likely it is to break. It does not wear smooth, it drops out in patches ; the small laminæ become loosened and the large scales fall off. Steel for rails is not made now as it was when steel rails were introduced. Then, the rails were made of ingots of steel ten or twelve inches square and of sufficient length to make one rail only. Now, the ingot is from fifteen to sixteen inches square and long enough to make three rails. The rails now made contain, as shown by analysis, practically the same percentage of carbon as those first made, yet they are much softer than those, because the granulations of the metal are coarser, the large size of the ingots being answerable for that. These granulations are bounded by a delicate layer of what is probably carbide of iron, and they become loosened very easily. This explains why the axles of car-wheels are liable to fracture. The fracture follows along the planes—even in wrought iron—of these apparent crystals (granulations). At the present time, the life of a steel rail is about one-half as long as when steel rails were first made. The wear of a rail is as follows : The rail rests upon ties. Dust, containing particles of grit, accumulates between the ties and the rail, and cuts and grinds away the metal under the motion of the rail produced by the passage of railway trains over the track. No means exist of securing the rails from the movements caused by trains in motion. The under side of a rail will thus be worn away one-eighth of an inch while the upper side is worn away one-quarter of an inch. A few years ago rails were enlarged at the top and lessened at the bottom, in consequence of the belief that they would wear better if so shaped ; but the result was, they wore out so rapidly at the base that their use became dangerous before the upper side was worn out : hence, the present shaped rail, which is large at the top as well as at the bottom."

EGGS OF THE CHRYSOPA OCULATA.

Mr. E. B. Southwick : "The position of the eggs is the peculiar feature of the object I have brought. They are the eggs of the lace-wing fly and are situated on silken stalks half an inch in length. The fly deposits its eggs in masses among swarms of plant-lice upon which the larvæ feed. The eggs are placed on these stalks in order that they shall be out of the reach of danger. The stalks are alike in size, and the material of which they are composed resembles in appearance the product of the silk-worm. I have not been able to find in books any satisfactory explanation of this egg-depositing process."

Mr. Beutenmüller: "It would seem that at present no one knows how these stalks are produced."

The President: "I have always supposed that the stalks were composed of a substance similar to the glutinous matter employed by insects sometimes for covering the egg mass. The stalks must be strong, for they support their burdens of eggs through rains and winds and all the vicissitudes of the weather. I have seen as many as twenty eggs in a cluster."

Mr. Braman: "I have found them attached to a culm of grass, seven or eight of them in a row, nearly one-quarter of an inch apart."

A PARASITE ON THE GALL OF THE SWAMP-ROSE.

The President said: "I have brought for exhibition a parasite found on the gall of the swamp-rose—a hymenopterous insect of the genus *Torymus*. Its species I do not know. There are a great many species which have not yet been determined. I submitted this parasite to Prof. Riley, of Washington, for identification. He has not yet determined its species. Six at least of these parasites were taken by me from this one gall. The gall (*Rhodites bicolor*, Harris) is very beautiful in its young and fresh state. It is as large as the fruit of the wild gooseberry, being about half an inch in diameter, and has spines one-third of an inch long projecting in every direction from its surface. When young and before its maturity it is very often cream-colored, shading into a vermilion. After maturity it changes to a dark-brown color.

"The parasite is remarkable for its long, stout ovipositor and for the extreme beauty of its colors."

The President exhibited and described a wooden case, designed by himself, the purpose of which was to hold in a small compass, without pressure, a considerable number of such plant specimens as would be injured if confined in the ordinary collection cases where they would be subjected to pressure.

Mr. William E. Damon was elected an Active Member of the Society.

BOOK NOTICES.

SECOND ANNUAL REPORT OF THE INJURIOUS AND OTHER INSECTS OF THE STATE OF NEW YORK. By J. A. LINTNER, State Entomologist. Albany: Weed, Parsons and Company. 1885. Pp. 265.

This Second Report, lately issued, is admirable in form and exceedingly valuable in material The continuous dealing with economic entomology throughout its pages amply verifies the author's statement in the Introduction, that it has been prepared with special reference to the benefit of the agricultural community. Its full descriptions of many injurious insects, their transformations and modes of attack, coupled with directions for the application of tried remedies, must be eminently interesting and valuable to any farmer who will heed them.

Besides other admirable characteristics which might be mentioned, this Second Report, fulfilling the hopes excited by its voluminous predecessor, is especially valuable, both to the professional and the amateur entomologist, on account of its republication of contributions to this department by Dr. Asa Fitch, its full record of synonomy and bibliography, and its complete table of contents, and its general and plant indexes—the two latter occupying about twenty pages.

NOTES ON HISTOLOGICAL METHODS, including a brief consideration of the methods of Pathological and Vegetable Histology, and the application of the Microscope to Jurisprudence. For the use of Laboratory Students in the Anatomical Department of Cornell University. By SIMON H. GAGE, Assistant Professor of Physiology, and Lecturer on Microscopical Technology. Pp. 56. Ithaca, N. Y.: Andrus & Church.

"The object of histological methods is to assist the investigator in obtaining a complete knowledge of the tissues. Complete knowledge of any tissue comprises, in the writer's opinion, an understanding of: (1) The gross anatomy. (2) The form, nature and relations of the structural elements. (3) The blood-vessels. (4) The lymph-vessels. (5) The nerve-supply,—the relation of the terminal filaments of the nerves to the structural elements. (6) The histogenesis or development. (7) The function or physiology of the tissue.

"At the present day, however, not a single tissue is known in all the detail indicated above."—*Extract from Prefatory Note.*

TOPICS.—(1) The Microscope and its Parts. (2) Learning to use a Microscope. (3) Slides and Covers; Interpretation of Appearances. (4) Magnification, Micrometry and Drawing. (5) The Study of living tissues. (6) Isolation and preservation of the structural elements. (7) Hardening tissues. (8) Section cutting and mounting. (9) Serial sections. (10) Fine injections. (11) Methods of pathological histology. (12) Methods of vegetable histology. (13) The Microscope in Jurisprudence. (14) Reagents and their preparation. (15) Bibliography.

HOW TO PHOTOGRAPH MICROSCOPIC OBJECTS. A Manual for the Practical Microscopist. By I. H. JENNINGS. New York: E. & H. T. Anthony & Co. Pp. 32. (Illustrated.)

"The following pages are presented to the practical microscopist as one of the best collections of useful information on photo-micrography that has appeared for many years. The author's standing amongst English scientific workers is a sufficient guarantee for the thoroughness of the methods and processes described, and we feel that American laborers in the same field will find them an invaluable aid in this interesting department of applied photography."—*Publisher's Notice.*

Lesson I.—Microscopical Apparatus. II.—Photographic Apparatus. III.—Illuminating Apparatus. IV.—Exposing the Plate. V.—Development. VI.—Defects in the Negative. VII.—Printing. VIII.—Preparing Objects for Photography. IX.—Preparing Entomological Slides. X.—Preparing Vegetable Tissues for Photography. XI.—Preparing Sections of Hard Substances for Photography. XII.—Preparing Crystallizations for Photo-micrography.

PUBLICATIONS RECEIVED.

National Druggist: Vol. VIII., No. 9 (February 26th. 1886); pp. 16. No. 10 (March 5th); pp. 12. No. 11 (March 12th): pp. 12. No. 12 (March 19th); pp. 12. No. 13 (March 26th); pp. 12.

Anthony's Photographic Bulletin: Vol. XVII., No. 4 (February 27th, 1886); pp. 32. No 5 (March 13th); pp. 32. No. 6 (March 27th); pp. 32.

The Electrician and Electrical Engineer: Vol. V., No. 51 (March, 1886); pp. 40.

Indiana Medical Journal: Vol. IV., No. 8 (February, 1886); pp. 22. No. 9 (March); pp. 22.

Proceedings of the American Academy of Arts and Sciences: New Ser., Vol. XIII., Whole Ser., Vol. XXI., Pt. I. (May to October, 1885); pp. 247.

Second Report of the Injurious and Other Insects of the State of New York (1885); pp. 262. By J. A. Lintner.

The West-American Scientist: Vol. II., No. 1 (January, 1886); pp. 10. No. 13 (February); pp. 5. No. 14 (March); pp. 5.

Proceedings of the Canadian Institute, Toronto: Third Ser., Vol. III., Fascic. No. 3 (February, 1886); pp. 45.

Proceedings of the Natural Science Association of Staten Island: February 13th, 1886; p. 1

Journal of the Royal Microscopical Society: Ser. II., Vol. V., Pt. 6a (December, 1885); pp. 45 + 57. Vol VI., Pt. 1 (February, 1886); pp. 192.

Bulletin of the Washburn College Laboratory of Natural History: Vol. I., No. 4 (October, 1885); pp 36.

The Naturalist's World: Vol. III., No. 27 (March, 1886); pp. 20.

Bulletin of the Torrey Botanical Club. Vol. XIII. No. 2 (March, 1886); pp. 16.

Bulletin of the California Academy of Sciences: No. 4 (January, 1886); pp. 213.

The Correspondence University Journal: Vol. III., No. 5 (March 15th, 1886); pp. 12

Notes on Histological Methods; pp. 56. By Simon H. Gage.

Journal of Mycology: Vol. II., No. 3 (March, 1886); pp. 12.

The American Monthly Microscopical Journal: Vol. VII., No. 3 (March, 1886); pp. 20.

The Botanical Gazette: Vol. XI., No. 3 (March, 1886); pp. 24.

Jahrbücher des Nassauischen Vereins für Naturkunde: Jahrgang 38 (1885); pp. 181.

The Microscope: Vol. VI, No. 3 (March, 1886); pp 24.

The Microscopical Bulletin and Science News: Vol. III., No. 1 (February, 1886); pp. 8.

Comptes-Rendus des Séances de la Société Royale de Botanique de Belgique: February 13th, 1886; pp. 14.

Ottawa Field-Naturalists' Club: Transactions No. 6, Vol. II., No. 2 (1884–1885); pp. 132.

INDEX TO ARTICLES OF INTEREST TO MICROSCOPISTS WHICH HAVE RECENTLY APPEARED IN OTHER JOURNALS.

Algæ, Fresh-Water, (including *Chlorophyllaceous Protophyta*) of the English Lake District ; with descriptions of twelve new species : Alfred W. Bennett.
Jour. Roy. Mic. Soc., VI. (1886), pp 1–15 (33 figs.).

Algæ of Fresh Water, Provisional Key to Classification of : R. Hitchcock.
Am. Mon. Mic. Jour., VII. (1886), pp. 50–2.

Astigmatism and its Relation to the Use of Optical Instruments further considered : E. Gundlach.
The Microscope, VI. (1886), pp. 63–5.

Bacteria. The Cultivation of, and the Cholera Bacillus : Lester Curtis.
Proc. Am. Soc. Mic., 1885, pp. 142–50.

Bacteria, On the Cultivation of : Edgar M. Crookshank.
Jour Roy. Mic. Soc., VI. (1886), pp. 25–31 (6 figs.).

Botrychium ternatum, The Development of the Root in : Douglas H. Campbell.
Bot. Gaz., XI. (1886), pp. 49–53 (10 figs.).

Butter and Fats. To Distinguish one Fat from another by Means of the Microscope : Thomas Taylor.
Proc. Am. Soc. Mic., 1885, pp. 128–38.

Cartilage, Studies of the Development of the, in the Embryo of the Chick and Man : M. L. Holbrook.
Proc. Am. Soc. Mic., 1885, pp. 76–82 (2 figs.).

Central *v.* Oblique Light : Edward M. Nelson.
Eng. Mech., XLII. (1886), pp. 527–8 (5 figs.).

Chick Embryos, On the Preparation of, for Microscopical Examination : W. P. Manton.
Proc. Am. Soc. Mic., 1885, pp. 66–70.

Diamond, in Ruling Lines upon Glass, Explanatory Notes on a Series of Slides presented to the Society, Illustrating the Action of a : W. A. Rogers.
Jour. Roy. Mic. Soc., VI. (1886), pp. 16–21.

Diatom Hoops, Some. The Question of their Mode of Growth (*Aulacodiscus Kittoni*) : Jacob D. Cox.
Proc. Am. Soc. Mic., 1885, pp. 33–7 (2 fig.).

Dried Beef, Poisonous : H. J. Detmers.
Proc. Am. Soc. Mic., 1885, pp. 54–9 (1 fig.).

Floscule, A New : D. S. Kellicott.
Proc. Am. Soc. Mic., 1885, pp. 48–50.

Focus, The Actinic and Visual, in Photo-Micrography : Jacob D. Cox.
Proc. Am. Soc. Mic., 1885, pp. 29–32 (2 figs.).

Infusoria, Fresh-Water, Observations on some : D. S. Kellicott.
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Infusoria, Fresh-Water, Stray Notes on : D. S. Kellicott.
The Microscope, VI. (1886), pp. 53–8 (4 figs.).

Microscopical Advances—Ancient and Modern (VI.): Dr. Royston Pigott.
Eng. Mech., XLIII. (1886), pp. 45–6.

Micro-Organisms, On the appearances which some present under different conditions, as exemplified in the Microbe of Chicken Cholera: G. F. Dowdeswell.
Jour. Roy. Mic. Soc., VI. (1886), pp. 32–6 (6 figs.).

Mounting Media of High-Refractive Index: Hamilton L. Smith.
Proc. Am. Soc. Mic., 1885, pp. 86–90 (1 fig.).

Muscle, First Development of, in the Embryo of the Chick and Man: M. L. Holbrook.
Proc. Am. Soc. Mic., 1885. pp. 71–5 (1 fig.)

Peridinium and other Infusoria, Notes on: Alfred C. Stokes.
Jour. Trenton Nat. His. Soc., I. (1886), pp. 18–22.

Photo-Micrographs, How to Make (III.): W. H. Walmsley.
The Microscope, VI. (1886), pp. 49–53 (2 figs.).

Photo-Micrography (IV.): R. Hitchcock.
Am. Mon. Mic. Jour., VII. (1885), pp. 48–50 (1 fig.)

Pollen-Tubes Again: J. Kruttschnitt.
Proc. Am. Soc. Mic., 1885, pp. 62–5 (5 figs.).

Pumice-Stone and other Vesicular Rocks, On the Preparation of Sections of: H. J. Johnston-Lavis.
Jour. Roy. Mic. Soc., VI. (1886), pp. 22–4.

Resolution, On "Central" Light in: J. W. Stephenson.
Jour. Roy. Mic. Soc., VI. (1886), pp. 37–9 (4 figs.).

Rocks, The Microscopical Study of: J. S. Diller.
Am. Mon. Mic. Jour., VII. (1885), pp. 41–2.

Rowland Gratings, Determination of the Absolute Length of Eight, at 62 Fahr.: W. A. Rogers.
Proc. Am. Soc. Mic., 1885, pp. 151–98 (3 figs.).

Sexual Organs of Reproduction in Angiosperms, Structure of the (No. 2.—Ovary of *Lilium*).
Cole's Studies in Mic. Sci., III. (1886), pp. 45–8 (colored plate).

Schimmelpilze, Intramolekulare Athmung und Gährthätigkeit der: N. W. Diakonow.
Ber. Deutsch. Bot. Gesellsch., IV. (1886), pp. 2–7.

Spheropsideæ, British (Continued): M. C. Cooke.
Grevillea, XIV. (1886), pp. 101–8.

Staining Tissues in Microscopy (Hans Gierke, *Zeitschr. für Wiss. Mic.*) (VIII., IX.): Translated by W. H. Seaman.
Am. Mon. Mic. Jour., VII. (1886), pp. 31–5; 53–4.

Testa of Several Leguminous Seeds, Structure of the: L. H. Pammel.
Bull. Torrey Bot. Club, XIII. (1886), pp. 16–24 (21 figs.).

Zahnplatten der Gattung *Limnæa*, Studien ueber die: W. Dybowski.
Bull. Soc. Imper. Nat. Moscou, LX. (1884), pp. 256–62 (8 figs.).

MISCELLANEA.

CARTILAGE.—An excellent source for hyaline cartilage is an end of one of the long bones of Necturus. The larynx of the cat also furnishes good material. Sections may be made free-hand of the fresh material as follows: Remove most of the soft parts covering the cartilage, wrap it in newspaper or other strong paper, and grasp it by the thumb and index of the left hand so that it projects slightly above the nail of the thumb and index. Wet the cartilage well with salt solution, and wet the razor or section knife with the same. Grasp the razor firmly, rest the blade on the nail of the thumb or index; move the razor forward across the tissue with a drawing cut, making each section with a single sweep of the knife. Make several sections, and transfer them to a dish of picric acid solution. They should be left in this half a day or more. They may then be washed with water and mounted in glycerin or glycerin jelly. If it is desired, the sections may be stained with alum carmine after soaking in water till the picric acid is removed. Stained sections may be mounted in balsam, but glycerin or glycerin jelly is preferable. As it is sometimes impossible or undesirable to make sections of fresh cartilage, the cartilage in small pieces may be kept in the picric acid for a few days, and then in 75 to 80 per cent. alcohol, until one is ready to make the sections. In that case the sections are transferred to water or 35 per cent. alcohol as they are cut, and the razor and tissue are wet with the 35 per cent. alcohol, with salt solution or with water. The sections must not be allowed to dry in any case. It is difficult for the inexperienced to make free-hand sections of sufficient thinness and evenness, hence the cartilage may be cut in the microtome as follows: Fill the well of the microtome nearly full of melted imbedding mass; dry one end of the cartilage with filter paper, and insert it into the melted mass so that the other end of the cartilage is about on a level with the top of the microtome. To prevent drying, place a small mass of absorbent cotton, wet with salt solution, over the exposed end of the cartilage. Cool the imbedding mass as soon as possible by the use of snow, ice or cold water. Wet the razor with salt solution and make the sections as rapidly as possible, using a drawing cut as in free-hand sections.—*Notes on Histological Methods, by Simon H. Gage.*

THE MICROSCOPE IN JURISPRUDENCE. — While an *entire* human body may be distinguished as such with certainty, histological knowledge is not, in my opinion, sufficiently advanced at the present day to enable one to say *that any microscopic structure is absolutely characteristic of and peculiar to a human being.*

While it is true that no one can say that a given microscopic structure is part of a human being, and not of any other animal, he might say with certainty, that it could not be from some animals in which the given structure is known to be very different. The histological or microscopical expert, in my opinion then, cannot give positive evidence with regard to the exact source of any microscopic structure. The *most* he can do is to say what it may be, and what it cannot be. Even this, unsatisfactory as it may seem, requires a profound knowledge of human and comparative histology, and of the changes that may be produced in the various structures by drying and dampness, by chemical and mechanical means. There is also often required a thorough knowledge of optics, and great manipulative skill. He, who, in the name of Science, allows himself through ignorance or design to become an advocate and not an expounder of the whole truth, so far as it is known, has been well characterized by Woodward as possibly more dangerous to society than the criminals he is called upon to convict; and the lawyer who through ignorance or design allows truth and justice to be so betrayed, is no better.—*Extract from Notes on Histological Methods, by Simon H. Gage.*

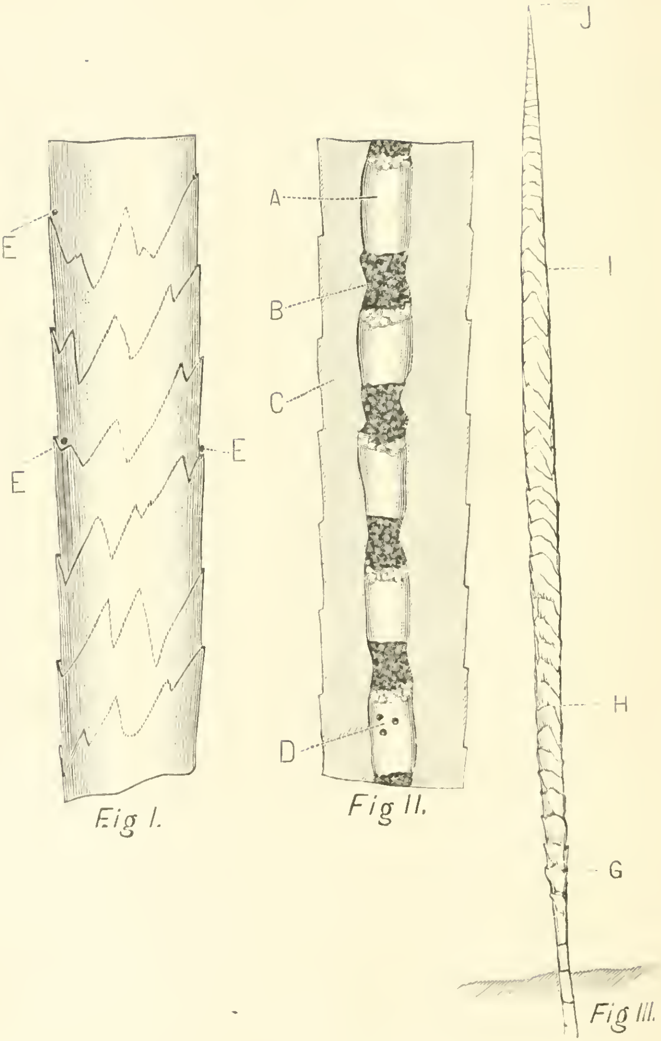


Fig I.

Fig II.

Fig III.

FUR FIBRES.

JOURNAL
OF THE
NEW-YORK MICROSCOPICAL SOCIETY.

VOL. II. MAY, 1886. No. 5.

FUR FIBRES.

BY H. L. BREVOORT.

(*Presented April 2d,* 1886.)

Plate III.

The structure of fur fibres differs from that of the hair fibre except in the interior portion. The fur fibre of the common rabbit is shown in plate III. Fig. 1 shows the exterior scales of the fibre. The interior appears somewhat as shown in Fig. II. The portion at *A* is an air cell. At *B* is a mass of pigment cells, which is the only material in these isolated portions, and gives color to the fur fibres. These pigment cells are almost all of a light brownish yellow color. In the darker furs they occur more frequently and the masses are larger and more compact. By treatment with glycerine they can be separated and then they drop into the air spaces. This formation is continued almost from the point of the fibre, which is of the shape shown in the upper part of Fig. III., to near the base. The air spaces interspersed with pigment cells are found from *G* to *J* (Fig. III.), but nothing can be seen, even with the most powerful objectives I have used, in the portion of the fibre below the point marked *G*; and so in the skin itself the root of the fibre is perfectly transparent.

I have found by long observation that the pigment cells gradually come out under the scales upon the exterior of the fibre, and then, when they meet the oxygen of the air, they appear to break up and supply to the fibre the water-repellent material on the outside. I have seen them pass to the surface, though the walls of the passage through which they moved were invisible; and I would suggest that that is probably the way in which all fibres with a scaly structure, such as human hair, are supplied with grease, or whatever the oily material may be with which the outside surfaces are furnished, namely, by the exudation of pigment granules from under the scales to the exterior of the fibre.

You see, also, why fur is such an excellent non-conductor. It contains an enormous quantity of air cells, in which the air is closely imprisoned, and these, when once warmed by the heat of the animal's body, will keep him warm for a long time. The walls of these cells are of such a character that glycerine will not penetrate them until they have been soaked in it for about two weeks.

Certain animals, as we all know, grow white in winter and dark again in summer, while others, particularly those that live in the South, such as the marsh-hare, grow black in the winter but become lighter again in the summer This seeming contradiction I think can be explained. So far as I have been able to discover by experiments on a few rabbits, the pigment cells on the approach of cold weather are discharged, to a great extent, or new fur fibres devoid of pigment are developed ; at any rate, the air cells are enlarged. This change enables the animal to resist dry cold. In the summer, when the animal is called upon to resist moisture, the amount of pigment is increased, while the air cells decrease, since at that season more water-repellent material is needed on the surface. And you will notice, also, that in most animals the back is darker than the stomach. This is because the cold of the ground has to be resisted when the animal lies down, while the back has to resist moisture. On the other hand, the swamp-hare of the South turns darker in winter, I suppose, because, under the conditions of its existence, it requires more water-repellent material.

The Arctic Fox turns almost pure white in winter because it has to resist dry cold, and in summer, when it has to resist less cold than moisture, it is not so white. This explanation, however, is simply a theory which opens an interesting field of inquiry, but which would take a long time to prove, and I should be glad if anybody would take the matter up.

I have observed under the pigment cells a series of colorless cells, but what function they perform in the fibre, I have not ascertained. They are present in almost all of the fibres.

In a fibre freshly taken from the animal, pigment cells that have worked out under the scales to the exterior, can, under a one-sixteenth or one-twentieth inch objective, be seen like little dots, as shown at *E*, Figs. I. and II. I have seen a pigment cell about half way out, which, in a few days, under my observation, worked its way entirely out.

I believe that the trail left by certain animals is caused by the rubbing off of some of these pigment cells, which I think contain some material which dogs can smell. Animals which leave the strongest trail always have dark hairs on the feet. The deer probably discharges some form of pigment cell from his hoof.

EXPLANATION OF PLATE III.

Fig. I., Exterior view : *E*, Pigment cells on exterior of fibre from the Common Rabbit.

Fig. II., Interior view : *A*, Air cell ; *B*, Compacted pigment cells ; *C*, Wall of fibre ; *D*, Loosened pigment cells.

Fig. III., Whole fibre: *G*, No scales ; *H*, Prominent scales ; *I*, Scales as in Fig I.; *J*, Scales gradually lessening toward point of fibre.

SPIRAL FIBRE OF THE BANANA STALK.

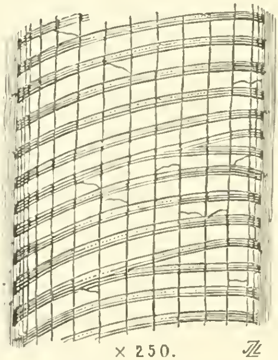
BY THE REV. J. L. ZABRISKIE.

(*Read April 2d*, 1886.)

The spiral fibres of the large stalk which supports the fruit-bunch of the Banana are remarkable for their abundance, large size, and beauty. If a prism be cut longitudinally from the inner substance of the stalk, one-quarter of an inch square and of any convenient length, and slight transverse incisions, all in the same plane, be made on the four sides, on slight bendings in various directions, the cells and vessels which have not been cut will break, and the portions of the prism on either side of the incisions may be gently separated, drawing out the spiral fibres in great abundance. These fibres tear away from their respective vessels in ribbons which vary greatly in fineness, as may be easily detected by the unaided eye. The appearance of ribbons is caused by parallel strands of the fibres, from three to thirteen in number, coming away together from their vessels, and adhering, until they are drawn for a considerable length. Many of them may be drawn out at least two inches before they break. In order to observe the beauty of the large ribbons, it is advisable to draw them out not more than half an inch, or their strands will be more or less separated, and will resemble in appearance straightened threads.

A thin longitudinal slice of the stalk shows that the spiral vessels, even when lying in immediate contact, vary greatly in size, from $\frac{1}{1000}$th to $\frac{5}{1000}$ths of an inch in diameter; and the fibres themselves vary correspondingly, the largest being about $\frac{1}{5000}$th of an inch in diameter.

One of the distinguishing beauties of the larger ribbons is occasioned by the fact that their fibres are crossed nearly at right angles by another set of apparent fibres of extreme fineness; this second set divides the surface of the ribbon into minute spaces, which are nearly squares or parallelograms, according to the distance between the cross lines, and gives the appearance of lattice work constructed of resplendent glass rods.



Spiral fibre of the Banana stalk.—A portion of a large spiral vessel.

The longitudinal slice shows that the second sets of fine fibres run longitudinally through the entire length of the large spiral vessels. They do not appear to occur in the smallest vessels, but are most numerous in the largest vessels, where a half longitudinal section will show as many as ten, and they gradually decrease in number in the respective vessels of decreasing size, until finally only two or three can be faintly discerned. These sets of fine longitudinal lines, crossing nearly at right angles the larger spiral fibres, appear to be the outlines of delicate, lengthened, nearly rectangular cells; and these cells appear either to form the walls of the spiral ducts or to have a peculiarly intimate relation to these walls. These fibres of the Banana polarize well.

OBSERVATIONS ON THE STRUCTURE OF CASTANEA VULGARIS.

BY P. H. DUDLEY, C.E.

(*Read April 2d*, 1886.)

The tissues of *Castanea vulgaris*, var. AMERICANA, A.DC., our chestnut, consist of vessels or ducts, tracheides, parenchyma, and libriform and septate fibres, which are so combined as to present a very complex structure in the fibro-vascular bundle or annual ring. The large vessels form during the first part of the season's growth, and are confined to from one-sixth to one-third of the ring, making two, three, or four quite definite, concentric rows.

In transverse sections, each vessel or duct is oval, the major axis being radial to the tree. In size they have large limits of variation in different trees. I find the major axis to range from 200 to 500 μ, and the minor axis from 180 to 410 μ.

These large vessels or ducts are jointed in lengths of from one to two diameters. After the third or fourth year they are filled with tissue which has been designated as Tyloses, and the impression has been conveyed that it is merely accidental. This view I do not accept. In the duramen these vessels or ducts, in this wood, are never empty or open, but are filled with tissue which at one period contained protoplasm.

Surrounding these large vessels or ducts are cells of little more than parenchyma, though they are lignified according to the indications given by either of the reagents Phloroglucin or Indol. These cells, which Sanio might call intermediate fibres, have septa, and in autumn and winter contain starch. The thin places in their walls are elliptical in some instances, and in others, round. The thin places in the walls of the vessels correspond to those of the adjacent tissues except those of the medullary rays, a modification in each taking place, and instead of being elliptical horizontally, they are often so vertically, and in many cases they are triangular in form. In the ring not occupied by the large vessels or ducts, many smaller ones are interspersed, not in concentric rows, but inclined from a radial direction to the centre of the tree; they gradually decrease in size to the outer portion of the ring. Surrounding these smaller ducts are tissues which may be classed as tracheides, being quite long and having an abundance of circular thin places in their walls.

Interspersed all through the bundle or ring are cells, possibly cambiform cells, with thin walls, which, in the alburnum, during the autumn and winter, contain starch grains. In this part of the wood, during the same season, the medullary rays also contain starch. The transverse walls in these cells are frequent, every three or four diameters in length containing a division. Another class of cells of much greater length, but little larger in size, are constricted at the transverse cell-wall, giving the appearance of slightly rounded ends. These do not differ much in appearance from the vertical cells in the *Sequoias*, which contain coloring matter. I tested them for tannin and they indicated its presence, but other cells also did the same.

The libriform cells in this wood have comparatively thin walls, and a large lumen. The quadrangular fibres surrounding the large vessels measure from 25 to 30μ in diameter, while the lumen measures from 19 to 25μ. The libriform fibres near the central and outer portion of the ring measure from 19 to 25 μ in diameter, the lumen measuring from 10 to 15μ in diameter. Nearly solid fibres are not found in this wood as in *Carya alba*, a closely allied tree.

In the tangential section, the medullary rays are found in single and in double rows; the former predominating. From one to thirty cells form the single vertical bundles—and in the others often only one or two cells are doubled. This wood splits easily. From the microscopical examination of this wood, one would class it as one of medium softness, which is found to be true by other tests. Its specific gravity ranges from .4 to .5 of one *per cent.;* a cubic foot of dry wood weighing from 26 to 32 lbs. In contact with the ground it is very durable, and when used for railway ties does not decay before the fibres are destroyed under the rails.

The large vessels it contains give veneers cut from the second-growth wood a beautiful appearance, and it is much used for interior finishing.

HIGH-REFRACTIVE MEDIA.

BY PROF. H. L. SMITH.

(*Read April 2d*, 1886.)

The results of experiments made subsequently to the discovery of the boro-glyceride and antimony-bromide medium, described in a preceding paper,[1] are of importance, and demand a brief notice. The antimony compound works very pleasantly, and still appears to be the best when high-refractive power is required ; but unless all excess is completely removed from outside the cover, it stains the protecting ring. The litharge and gold-size ring and the zinc-white ring are merely darkened ; but the black asphalt ring is softened. Thoroughly cleaning off the excess around the cover remedies this difficulty.

The chief improvement I would make in the formula given, I now think, is the substituting of stannous chloride for antimony bromide, and of arsenious acid for boracic acid.

I find that a compound of stannous chloride, arsenious acid and glycerine is so very slightly deliquescent, that the mounts may be left for weeks without cleaning off the excess, and that very little if any softening of the material ensues. The mounts are easily cleaned, as the cover is very firmly attached.

The medium is not so liable to turn when heat is applied, as when boro-glyceride or gelatine and glycerine is used ; the latter, indeed, for that reason, is quite objectionable. The refractive power of the mixture is not quite so high as when antimony bromide is employed ; but the refractive power is quite high enough for anything except the most hyaline tests ; and as a little excess of material outside the cover does not discolor the ring, and does not seem to alter by quite long standing without a ring, I now prefer this compound.

This medium is prepared as follows : Weigh out six parts of stannous chloride, and two to two and one-fourth parts of pure arsenious acid. Melt the stannous chloride in a test tube and boil it for a little while; add while hot an amount of glycerine equal to the bulk of the melted stannous chloride, not more ; heat and shake until it forms a perfectly clear solution. Add now, little by little, the arsenious acid, constantly shaking and heating until all is dissolved. This mixture when cold should be very viscid.

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[1] See this Journal, *ante*, p. 13,

In making a preparation with this medium, at first, on heating, a great number of small bubbles may appear under the cover. A little more heating enlarges these to steam-bubbles, then, by allowing the slide to cool a little, the cover will settle down, and most of the bubbles will disappear ; but if any are still present, another application of the heat of a small flame under the slide at the edge of the cover, where the bubbles are most abundant, will remove them. Towards the completion of the preparation, the slide may be inverted, if necessary, and the small flame allowed to play directly on the edge of the cover ; thus, careful treatment will dispose of all bubbles. When cold, the excess is easily removed with a moistened roll of tissue paper, and, finally, after the cleaning, the slide should be warmed just sufficiently to expel any moisture that may have found its way under the cover. If, after the ring is applied and the preparation otherwise completed, any metallic stain should show on the cover or slide, it can be removed with a roll of tissue paper moistened with hydrochloric acid.

The arsenious acid also makes an excellent compound with the antimony bromide ; and the highest-refractive-power white medium that I have yet seen is made as follows : Melt antimony bromide and add to it while hot half its bulk of glycerine ; in this put arsenious acid, little by little, shaking and heating at the same time, until by its solution the bulk is increased three-fourths of one part, so that the final mixture will be : antimony bromide 2 parts, glycerine 1 part, arsenious acid ¾ part, all in bulk. This compound is solid, or very nearly so, when cold, and will require slight warming to take out a drop on the dipping-rod. It does not soften much, if at all, on exposure, and its refractive index is well on towards 2. The mounts made with this material are very satisfactory.

Finally, I think that the yellow medium, the compound of "realgar" and bromide of arsenic, can be made permanent and easy to use by the addition of a small excess of sulphur. The realgar is broken up and dissolved, by the aid of heat, in the bromide of arsenic. The solution is evaporated until, when cold, it becomes so viscid as to flow with difficulty ; enough sulphur is now added to increase its bulk about one-sixth (I have not been able to determine the exact proportions yet), and thoroughly dissolved ; it becomes now somewhat more limpid, and is used as one would use balsam. It requires a very high heat to boil, so the slide must be heated cautiously ; but there is no difficulty in boiling, and this should be continued for a little while, when the cover will settle down entirely free from bubbles, and, if the user is careful not to slide it, may be gently pressed down. When cold, the deep color will disappear and the cover will be very firmly fixed. To use this medium, the best polished slides must be obtained, as all the pits and scratches of ordinary slides show up very disagreeably. The covers also must be well cleaned. I have preparations which were made with this material more than three months ago, that show no symptoms of change.

Too much sulphur, however, will, in time, crystallize. I cannot now state what proportions can be safely used, but the amount named above, thus far appears within limits.

NOTICE OF A NEW LOCALITY FOR HAPLOPHRAGMIUM CASSIS, A RARE FORAMINIFER.

BY A. WOODWARD.

(*Read April* 16*th*, 1886.)

While spending my vacation during the summer of 1884 on Peak's Island, situated in Portland Harbor, Maine, I dredged for microscopical objects in the channel between Peak's and Great Hog Islands.

The depth of water was from about four to thirteen fathoms at low tide.

I made several very successful hauls, bringing up many species of Gasterpods, Lamellibranchs, Crustaceans, etc. ; also much mud of a bluish gray color, some of which I washed carefully through a fine-meshed cloth until the water ran perfectly clear. Upon examining the residue with a pocket lens, I found, to my surprise, the very rare arenaceous foraminifer, *Haplophragmium cassis*, in great abundance, associated with the following forms, which are common on our coast; viz.,

Biloculina ringens, Lamarck, sp.

Nonionina depressula, Walker and Jacob, sp.

Polystomella striatopunctata, F. and M.

Previously to this find, the distribution list comprised only three localities; namely,

Gaspe Bay, mouth of the river St. Lawrence, 16 fathoms (Dawson).

Lively Harbor. Disco, Greenland, 5 to 20 fathoms (Norman).

Deva Bay, Spitzbergen, 7 fathoms (Robertson).

I now add the fourth :

Portland Harbor, Peak's and Great Hog Islands, 4 to 13 fathoms (Woodward).

These foraminifera are about one-eighteenth of an inch in length ; the chambers are composed of grains of sand strongly cemented together. The walls, however, are thin and brittle, and it is almost impossible to select them from the sand in which they are found without breaking, except by taking them up with a bristle.

PROCEEDINGS.

Meeting of April 2d, 1886.

The President, the Rev. J. L. Zabriskie, in the chair.

Thirty-two persons present.

OBJECTS EXHIBITED.

1. Sections of *Castanea vulgaris*, var. Americana, A. DC. : by P. H. Dudley.
2. *Streptococcus Vaccinæ*, Animal : by W. H. Bates, M. D.
3. *Streptococcus Vaccinæ*, Humanized : by W. H. Bates, M. D.
4. Spiral Fibre of Banana Stalk : by J. L. Zabriskie.
5. Ouvarovite (Chrome Garnet) from Oxford, Canada : by G. F. Kunz.
6. Native Iron from Ovifak, Greenland : by G. F. Kunz.

STRUCTURE OF CASTANEA VULGARIS.

Mr. Dudley read a paper on the structure of *Castanea vulgaris*, which constitutes the third article in this Number of the Journal.

In response to inquiries, Mr. Dudley further stated, that the large ducts described by him extended through what would represent one year's growth, and are continuous from year to year ;

but they divide, and, after three or four years, are filled with tissue, and there is probably little or no circulation in them ; that he had without difficulty traced them through a twelve-foot board. This was the longest he had observed.

He had observed tyloses in a great many other species, and, besides, in all the oaks and locusts. It was some time before he had noticed this tissue in cutting sections. The knife not being sharp enough, tore the tissue out. It remains in the old wood of the oak, and is about the last thing to decay. The Society would remember that in a photomicrograph exhibited by him some time ago, it was shown that the mycelium of a fungus had destroyed the greater portion of the fibres, but this tissue remained intact.

The President said that he had found that these cells, in various species of the oak, would resist severe treatment. They are not always found in the duct when the section is cut. He had used a sharp knife, but the tissue would frequently come away in cutting the section, even when the greatest care was used.

FUR FIBRE.

Mr. Brevoort gave to the Society the result of some observations made by him in studying the subject of fur fibres, which will be found in the first article in this Number of the JOURNAL.

STREPTOCOCCUS VACCINÆ.

Dr. W. H. Bates exhibited two slides showing *Streptococcus Vaccinæ*, Animal, and Human, and said : "The first occurs in minute, oval cells, either single, double, or in chains. The specimens exhibited show all these conditions. The humanized is the same after it has passed through the body. These organisms are found at the point of vaccination, both in man and in the lower animals, after inoculation."

SPIRAL FIBRE OF BANANA STALK

The President exhibited a slide showing spiral fibre of the Banana stalk, and read a paper describing the structure of the fibres, which is published in this Number of the JOURNAL.

PLAGIOGRAMMA VALIDUM.

Mr. Schultze exhibited a photomicrograph of a newly discovered diatom, obtained from material from Barbadoes, and which had been named *Plagiogramma validum* by Prof. H. L. Smith.

HIGH-REFRACTIVE MEDIA.

Prof. H. L. Smith's paper on "High-Refractive Media" was read by Mr. Van Brunt (*Supra*, page 75).

Mr. Van Brunt: "Professor Smith's experiments have been very extensive, and the formulæ given by him are the result of a vast deal of labor, and he should be thanked for his experiments. I have obtained some curious results in repeating these experiments of Prof. Smith, which I would like to present at a future meeting.

"Prof. Smith has been trying to discover a medium in which diatoms may be mounted so as to show their structure under the most favorable conditions, and I think he will eventually succeed."

The Corresponding Secretary announced that the Society had been invited by the Torrey Botanical Club to attend a lecture to be delivered by Prof. W. G. Farlow, of Cambridge, Mass., before the Club, on the 9th instant, at Columbia College, on the subject of "Fungous Diseases of Plants."

On motion, the Corresponding Secretary was instructed to convey the thanks of the Society to the Torrey Botanical Club for the invitation.

Mr H L. Brevoort was appointed a special committee on Textile Fibres.

Meeting of April 16th, 1886.

The President, the Rev. J. L. Zabriskie, in the chair.

Thirty-one persons present.

OBJECTS EXHIBITED.

1. *Haplophragmium cassis*, Parker's Sp., from Portland Harbor, Maine: by A. Woodward.

2. Scalariform Ducts in the Tree-Fern *Dicksonia antarctica*: by C. S. Shultz.

3. Section of Cat's Tongue: by C. S. Shultz.

4. *Bacillus tuberculosis*: by W. H. Bates, M. D.

5. Photomicrograph of *Bacillus tuberculosis*: by W. H. Bates, M. D.

6. Rutile Crystals, from Burke Co., North Carolina: by G. F. Kunz.

7. Scalariform Cells of the wood of the Sweet-Gum tree (*Liquidambar Styraciflua, L.*): by J. L. Zabriskie.

8. *Bacterium lactis*, Lister: by P. H. Dudley.

HAPLOPHRAGMIUM CASSIS.

Mr. Woodward's note "On a new locality for *Haplophragmium cassis*" was read.

COTTON FIBRE.

Mr. Brevoort exhibited some photomicrographs of cotton fibre obtained from a friend who was connected with a large Cotton Manufacturing Company, and explained the method employed by the company in the microscopical examination of cotton fibre, which is as follows:—

As the cotton is received, samples are taken from each bale and photographed, and from the appearance of the photomicrograph and an examination of the cotton it is determined which bales shall be mixed in manufacturing.

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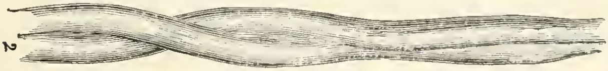

The spirality of the fibre is first looked for. The cotton with spiral fibre will twist together much more readily than the cotton whose fibre is comparatively flat and straight. In manufacturing, the spiral fibre makes less waste and a more even thread. A fibre with good thick edges will give strength to the yarn, while the oil deposits present in fibre make the yarn smoother and more elastic. The evenness in diameter causes the fibre to draw more evenly, and makes a smooth round thread. Fibres with spirality, good thick edges, well filled with oil, and even in diameter, will make good cloth with little waste, while round, straight fibres will make weak yarn with a large amount of waste.

LIQUIDAMBER STYRACIFLUA.

The President exhibited a longitudinal, radial section of the wood of the Sweet-Gum tree (*Liquidamber Styraciflua*), and, in explanation of the exhibit, described in what directions cuttings of the wood had been made to furnish the sections shown. He also described the scalariform cells and their structure.

Mr. Pellew was appointed a special committee on Bacteriology.

PUBLICATIONS RECEIVED.

The Journal of the Quekett Microscopical Club: Ser. II, Vol. II., No. 13 (October, 1885); pp. 213. No. 14 (February, 1886); pp. 34.

Brooklyn Entomological Society. Entomologica Americana: Vol. II., No. 1 (April, 1886); pp. 20.

The American Museum of Natural History, Central Park, New-York City. Annual Report of the Trustees for the year 1885–6; pp. 52

Bulletin de l'Académie d' Hippone: No. 21 (1885), Fasc. 1; pp. 67.

Bulletin de la Société Impériale des Naturalistes de Moscou: Vol. LX., Pt. 2 (1884); pp. 206. Vol. LXI., No. 1 (1885); pp. 264.

Johns Hopkins University, Baltimore, Md. Studies from the Biological Laboratory: Vol. III., No. 5 (March, 1886); pp. 49.

Bulletin of the Torrey Botanical Club: Vol. XIII., No. 4 (April, 1886); pp. 20.

The Naturalist's World: Vol. III., No. 28 (April, 1886); pp. 20.

The Journal of Microscopy and Natural Science: Vol. V., Pt. 18 (April, 1886); pp. 64.

The Electrician and Electrical Engineer: Vol. V., No. 52 (April, 1886); pp. 40.

The Hosier Naturalist: Vol. I., No. 6 (January, 1886); pp. 18. No. 8 (March); pp. 12.

The Aurora. Iowa State Agricultural College: Vol. XIV., No. 1 (March, 1886); pp. 19.

Anthony's Photographic Bulletin: Vol. XVII., No. 7 (April 10th, 1886); pp. 32. No. 8 (April 24th); pp. 32.

The Journal of the Cincinnati Society of Natural History: Vol. IX., No. 1 (April, 1886); pp. 64.

Proceedings of the Natural Science Association of Staten Island: March 13th, 1886; p. 1. April 10th; p. 1.

National Druggist: Vol. VIII., No. 14 (April 2d, 1886); pp. 16. No. 15 (April 9th); pp. 12. No. 16 (April 16th); pp. 12. No. 17 (April 28th); pp. 12.

The Journal of Mycology: Vol. II., No. 4 (April, 1886); pp. 12.

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JOURNAL

OF THE

NEW-YORK MICROSCOPICAL SOCIETY.

VOL. II. JUNE, 1886. No. 6.

THE MICROSCOPICAL STRUCTURE OF THE IRON PYRITES.

BY ALEXIS A. JULIEN, PH.D.

(*Read May 7th*, 1886.)

IN the black mud of ditches and pools, and of the flats exposed at low tide, in the muck of salt-marshes and the peat of fresh-water swamps, in the soil, in the very mud between the stones in the pavements of our streets, there is a substance constantly present and yet very unfamiliar, of whose office in nature, or even of whose very existence, man rarely becomes conscious. Continually formed by the contact of iron oxide with the sulphur separated from decaying organic matter, it is yet in the highest degree unstable, and continually in a state of decomposition back again into its two constituents, under the action of the air and of vegetable acids. Then the fetid vapors of hydrogen sulphide which it evolves testify decidedly to its existence, at least before the court of one of our senses—sometimes as an offensive stench, when these vapors rise from a ditch in a Long Island or a New Jersey salt-marsh—and sometimes as a rather welcome though quaint odor, delightfully associated with all the mirth and music and sanitary expectations of a summer visit to the Sulphur Springs of New York or Virginia. On the other hand, mineralogists recognize that this substance rarely, if ever, becomes concentrated in masses visible to the eye, never crystallizes, and is never found as a pure, isolated mineral, except, strange to say, within some meteorite which falls from the sky, and shows among its constituents dark rounded grains of the same material in the form of troilite. Even its innumerable black particles, scattered through the marsh-mud, are dull and amorphous, and almost always indistinguishable under the microscope, resembling mere granules of carbonaceous matter. Nevertheless, it is everywhere diffused in enormous quantities throughout the softer deposits at the bottoms of the ocean, lakes, and running waters, quantities perhaps equalling or exceeding those of the pyrites visible in the rocks. Its constant and universal formation doubtless serves the important purposes of rendering the iron oxides freely soluble in water, of assisting their later distribution as a cement through sandstones, and of causing their final accumulation as bodies of iron ore.

The substance to which I refer, is termed Iron protosulphide. It has a very simple composition, a single molecule containing one atom of iron to one atom of sulphur, indicated by the formula FeS. I have but repeated the ordinary view in stating that it does not occur on the earth as a distinct, isolated mineral; nevertheless, there are grounds, long ago advanced by the chemist Frankenheim, for believing that this substance, iron protosulphide, does exist as a well-known crystallized mineral; and it is from this point of view that you are asked to-night to examine in the first slide, the rare, hexagonal crystals of brown-colored pyrrhotite from a vein at Elizabethtown, Canada. The brilliant iridescent tarnish which these display, perhaps accounts for the few occurrences of the unstable mineral in that form. Under the name iron pyrites, with which all are familiar, there are really comprised three distinct minerals; namely, Pyrrhotite, Marcasite, and Pyrite, three comrades, clinging closely, hard to be parted. Where one is, one or both of the others may be found not far off. The one I have already mentioned, pyrrhotite, is, I believe, the elder brother, almost always the first one to be born—when metamorphism sets in and a rock comes into being—out of the black mother-slime, rich in iron sulphide, which permeates the silt and soil and mud-banks of the earth's crust. But oxygen, all pervading, is the constant foe of this simple compound, robbing it at its very birth of a variable portion of its iron, so that the number of its atoms of sulphur always exceeds those of iron; *e. g.*, thus, $Fe^7 S^8$, instead of $Fe^8 S^8$, which should comprise eight molecules of pure iron protosulphide.

In the further course of the subterranean conflict, in which the oceanic sediments consolidate, the robbery to which I have referred is consummated by the disappearance of half the original amount of iron. Thus, marcasite is born, consisting of iron di-sulphide, $Fe^4 S^8$, or more simply expressed, $Fe S^2$. This is a steely-grayish white mineral, often affected by a greenish tinge, crystallizing after an entirely different fashion, the rhombic, and having a peculiar tendency to originate in calcareous rocks; *e. g.*, the chalk of England and the Carboniferous and Trenton limestones of this country. From a pound of the latter rock from Jefferson County, New York, digested in acid, over an ounce of marcasite, in drusy crusts of pure and brilliant crystals, was left as a dark sediment. A glance at the second slide will convey a sufficient idea of the steely color, the curious involved crystallization, and the deeply striated faces which commonly characterize this mineral.

You will notice also, in the same slide, here and there, delicate white needles in radiating groups, planted on the surface of the marcasite crystals. These consist of "copperas," or "white vitriol," *i. e.*, sulphate of iron, and are the first evidences of the attack and absorption of oxygen from the air.

But in the next slide, the marcasite from Galena, Illinois, we have a striking example in miniature of that iridescent tarnish, examples of which are to be found in the cabinet of every mineralogist, a gaudy display of color, which, like that of the autumnal foliage of our forest, is only a proof of weakness, of oxidation by the air, and of coming dissolution, but in the case of the mineral, with no hope of the re-birth and of the new term of life which follows in the case of the tree.

The last member of the triad of the pyrites is Pyrite, which is found in brass-yellow cubes or octahedra, breaks with a conchoidal fracture like porcelain, and yet has exactly the same composition as marcasite, $Fe S^2$. In general, it is also found at the last stage of the alteration of crystalline rocks, where a high temperature has prevailed, as in the gneiss and magnesian marbles of New York Island. In its pure form, which almost defies oxidation, you may see it in the polished faces of this cube from Chili, in which you will notice that the microscope only confirms the ocular evidence of its density and purity. But here, on the other hand, is a granular form of the mineral from New Jersey, decaying so fast that the formation and expansion of the vitriol crystals within it are rending it to pieces. In the next slide, a fragment of this granular mass presents to the eye an aggregate of little bright cubes of pyrite, but no apparent reason for this speedy destruction. To solve this difficult problem of the varying stability and instability of crystals of the very same mineral, I ask your attention next to the octahedral crystals of pyrite from Weehawken, New Jersey. You will notice that the faces of these are covered by a more or less marked iridescence, reminding you of that already shown on the marcasite crystals of Galena, Illinois, although no visible trace of that mineral can here be detected. It is significant, also, that, in these crystals of pyrite, the tarnish is not uniformly dispersed over the surface, but very often presents alternating narrow stripes of color, blue or green with red. These lie sometimes in a set parallel to one edge of a triangular face, sometimes in two or even three intersecting sets, parallel respectively to the three edges of a face of the octahedron. This implies that the oxidation of the material has not progressed uniformly, and can hardly be explained except on the supposition that the pyrite encloses some unstable impurity, arranged in correspondence to crystallographic symmetry. The mineralological microscopist will recall many analogous instances of a similar internal arrangement of impurities, caught up during crystallization, such as those in the cruciform macles of chiastolite from Lancaster, Massachusetts. In these bright pyrite-crystals, it is true, the secret enemy, which effects their destruction on weathering, is diffused in a form far more minute, almost one of molecular isolation. But although the distinction of its particles exceeds all the powers of the microscope, its presence is here clearly revealed, as I believe, through the play of chemical forces and the subtile testimony of light.

The oxidation of the Weehawken pyrite, however, does not stop with this iridescent tarnish. The last change of all is shown in its complete alteration into a liver-colored limonitic iron ore, and yet, as displayed in the next slide, with the almost perfect preservation of the surface polish, and of the sharpness of its edges. Some mystery has always been attached to the origin of such hepatic pseudomorphs of iron oxide, presenting the crystalline form, properly belonging to pyrite. Your attention is further invited, therefore, in these Weehawken pseudomorphs, to the delicate reddish-brown crusts, deposited upon some of the crystal faces. On a cross-section, these crusts show alternating brown and white lines, evidently the edges of alternating films of red iron oxide, and white gypsum, of which these crusts are made up.

The chemist will understand that, as fast as the iron sulphate has been formed by slow oxidation of this pyrite, the iron oxide has been at once precipitated by calcium carbonate, derived from the surrounding calcite-gangue ; the gypsum resulting has been mostly washed away, except in the case of occasional films thus protected by envelopment.

We are here met by questions of great practical importance. Is it safe to roof a house with slates full of cubes of golden-yellow pyrites? Practical roofers and scientific observers agree that there is no danger of decay and discoloration with the pyrites of some slate quarries. What makes this difference, and how can we determine whether to accept or reject enormous bodies of pyritiferous slates which are found ready for quarrying? Again, when coal is brought out from the mines of Pennsylvania, it is piled up ready for shipment ; but these piles must often remain for months exposed to the weather, until the market requires their delivery. Why is it that the product of some collieries soon crumbles to a powdered condition, with great injury to its market value, while that from other localities resists decomposition and crumbling? This variation has been suspected to have connection with some conjectured peculiarity in the little bright grains of pyrites, abundantly scattered through most varieties of coal. But what is its real cause, and how can such disastrous results be anticipated, and therefore prevented?

Again, most residents of New York City have noticed the offensive and unequal yellow discoloration which has attacked the once pure white marble of our Court House building, a stone which was brought from a quarry in West Stockbridge, Massachusetts. This stone is full of decaying particles of pyrites, and yet the marbles from other beds in the same State, and in Vermont, contain forms of pyrites which appear to be perfectly stable in character. How can a builder distinguish between the two kinds of the same mineral, pyrite, whether stable or unstable, and decide whether to accept or reject a stone? In illustration of this last subject, I present a slide of the white marble of Lee, Massachusetts (from a block exposed to the weather for a few months), with a band of discoloration around a decaying particle of unstable pyrite; also another, on which are mounted a number of the crystals, yet unaltered, and from the same marble, which were obtained by dissolving away five pounds of the stone. There was some doubt whether so unstable a form of pyrites might not consist of marcasite only; but these crystals show the form of an ordinary modification of cubes of pyrite of pale brass-yellow color and apparent purity, with no visible reason for decay. In another slide are mounted the siliceous and insoluble minerals associated with the pyrite in the same marble; viz., tourmaline, phlogopite, tremolite, quartz, and rutile, all in such small quantities as to have escaped detection in the chemical analyses of this rock, though easily recognized in this way under the microscope.

In searching for the cause of these great differences in the same mineral, little use has hitherto been made of the microscope. Berzelius alone has recorded a microscopical examination of an efflorescent marcasite, simply stating that, "seen under the microscope, it presented a mass seamed by little cracks filled with a white and efflorescent salt, whose interstices appeared to consist of white pyrite unattacked and more or less crystalline;" also, on dissolving out the efflorescent salt, he could distinguish no sulphur in the residue.

In connection with a chemical examination which has been presented elsewhere (before the New York Academy of Sciences), I have resorted to the microscope in the hope of getting new light. I selected, as a material most promising of results, a portion of a nodule of pyrite in a state of decomposition, from Marsden's Diggings, Illinois. The conical specimen consisted of a finely fibrous material, with fibres about eight centimetres in length, and mostly 0.2 millimetre in thickness, radiating from the apex of the cone (the centre of the original nodule), becoming coarser toward their outward extremities, and there terminating in a close aggregation of distorted cubes, 4 to 8 mm. on a side. The inner material was of a pale yellowish-white color, and exceedingly brilliant lustre, crossed by three or four concentric lines of concretionary growth; an easy cross-fracture occurred at the lines, leaving a surface—across the ends of the fibres—which appeared to the eye perfectly aphanitic in texture, exceedingly brilliant and slightly mammillary. At the outer surface the aggregated cubes were stained to a brownish-black, variegated by delicate whitish efflorescence within the interstices. This efflorescence was found to penetrate to a depth of about 1 to 2 centimetres below the surface along the fibres, and even to the very centre of the nodule, at a depth of 8 centimetres along certain widened fissures among the fibres. The material differed little from that of similar fibrous nodules from Galena, Illinois; Linden, Wisconsin, and other localities. Various fragments of this material were mounted for examination by reflected light, and for this purpose, low magnifying powers, up to 200 diameters, were found sufficient, with the help of the plane mirror of a Sorby reflector.

The following materials were thus examined :—

A. A fibrous plate of the fresh and brilliant material from the interior. The surface of this natural fragment was divided up, through the fibration, by strongly marked lines, sometimes perhaps indicating open fissures, 0.033 to 0.134 mm. apart. Within these, in many places, a still finer lining occurred, the lines being sometimes only 0.014 mm. apart. These finer lines, coinciding with the cubic cleavage, were sometimes parallel to the main fibration, sometimes perpendicular to it. Elsewhere, they were commonly arranged obliquely, at an angle of 45° to 53° from the general direction, sometimes even in two sets, passing obliquely off in opposite directions from a median line; these latter oblique lines doubtless mark the octahedral cleavage of pyrite, often greatly distorted by pressure, and even, thereby, rendered curvilinear. A want of homogeneity was suggested by a number of bright, angular, yellow particles and grains scattered over the white and duller surface; their size usually varied from 0.013 to 0.084 mm.

B. A fragment from a plane at right angles to that of *A*, presenting the polished mammillary, and curved surface from the cross-fracture. The entire surface was found to be not uniform as it appeared to the eye, but seamed and slightly roughened by short fissures, marking the cubic cleavage, running at right angles to each other, but rarely intersecting, dividing up the surface into square spaces about 0.01 to 0.015 mm. on a side.

The same bright-yellow grains appeared here and there, as in *A*, but mostly as lines or thin branching veins, apparently the edges of films of yellow material, enclosed in the paler-colored pyrite.

C. A portion of the side of a fissure evidently—to the eye—darkened and roughened by incipient decomposition, but still apparently perfectly dense and compact. This showed under the microscope a remarkable subdivision and disintegration, the whole surface being seamed by minute cracks, mostly along and across the fibres, and also irregularly pitted and even honeycombed with cavities of the most irregular shape and size : all this surface was sprinkled and coated with granules and needles of the white efflorescence. The phenomena differed widely on every surface examined, but mostly comprised the following points of structure in the pyrite itself :—

1. A coarse columnar structure, that of the fibration, presenting a width of about 0.08 to 0.25 mm. between the parallel fissures, whose lips were separated about 0.005 mm. This was crossed, with more or less irregularity, by fissures at right angles, often producing the effect of an imperfect tesselated pavement, or of rude masonry. In places, the disintegration had gone so far that the mass consisted of dark roughened needles, attached at one end, or both.

2. The surface intervening between these cracks was pitted with cavities of the utmost irregularity of size and form, though commonly approximating 0.004 to 0.009 mm. in diameter, scattered in rows and in large groups. As a result of the subdivision produced by these cracks and pits, I estimated that the greater part of the mass was separated into little grains, approximately cubical in form, and about 0.01 mm. on a side. It would require about a thousand millions of such little grains to make up a cubic centimetre of the material, and the surfaces of these would present a superficial area about ten million times that of the superficies of a solid cubic centimetre.

3. The surface between the little pits further shows a very delicate striation, apparently caused by fine cracks or by minute ribs and furrows, all parallel to the line of fibration, but slightly wavy. On an average, about 555 of such lines occupied the distance of one millimetre across the fibration ; *i. e.*, they were about 0.0018 mm. apart. They projected very slightly above the intervening furrows, and produced the impression that they were lines of accretion running in the direction of the general fibration, and originally producing that structure ; that they represented the edges of thin films of a compact material,

flattened out by intense lateral pressure, whose irregularity had produced the wavy disturbance of their lines ; also, that their material was harder and perhaps brighter than that in the intervening furrows, and that their projection above the surface was but a feature of the general erosion, caused by their greater resistance to decomposition than that offered by the intervening films.

4. The suspicion of the want of homogeneity of the material was increased by the occasional distribution, over the dull eroded surface, of minute bright grains, scales, pellicles, and angular, sometimes branching rods, contrasting with the general surface by their brilliant lustre, yellow color, and sometimes, a slight projection. Many consisted of barely visible particles and lines, but some were noticed of the size of 0.005 to 0.035 mm.

Occasionally, triangular and rectangular outlines 0.056 mm. in length, and rarely two or three faces of a flattened polished cube could be distinguished. Their compact, bright material appeared identical with that of the striation films, and, in fact, many of their forms appeared as mere expansions or projections of these films. All the facts strengthened the idea that the material of this fibrous pyrite is not uniform, as it appears to the eye, but that these grains and minute lines indicate the planes of successive envelopment of two materials, the one yielding rapidly to decomposition, the other more dense and yielding more slowly.

The little pits or cavities were also closely examined to determine whether they ever presented symmetrical outlines, which might signify the eating away of crystals of a softer substance, but no such indications were recognized.

D. The darkened surface of a cube from the outer surface, slightly marked to the eye by minute particles of the vitriol-efflorescence. This presented under the microscope a finely granular mass of the pyrite material, seamed and interspersed with the white particles, grains, and sometimes needles of copperas in an almost continuous network. The surface was, in general, deeply and very irregularly eaten out and honeycombed in pits and cavities divided by jagged angular septa ; these cavities often presented a diameter of 0.06 to 0.10 mm., with a depth of about the same amount. Many of the grains of pyrite displayed cubical outlines, about 0.025 mm. on a side, which indicated the full development of the cubical cleavage.

On similar corroded and effloresced surfaces, on the side of fissures below the point where the cubes were developed, the eroded pits were a little larger, about 0.167 mm. in diameter, but the grains of pyrite did not exhibit cubical forms.

From these observations we may gather :—

1. In these fibrous nodules of pyrites, the fibres consist of elongated cubes, whose outward growth and mutual compression have produced a condition of great tension.

2. The material consists mainly of a diluted mixture of pyrite with a paler-colored and unstable impurity. Through this mixture more or less pure pyrite is diffused in alternating films, or in scattered strings and crystals of deeper-yellow color than their matrix.

3. The oxidation of the material has been facilitated by its heterogeneous composition, by its fissured structure, and by the tension among its fibres. It has progressed more rapidly in the predominant pale-colored mixture, has penetrated along the seams between the fibres, and has then been hastened by the development of the more minute fissuring as the result of the tension.

4. The development of this system of minute fissures has furnished an enormous area for the internal condensation of gases and vapors from the atmosphere, chiefly oxygen and moisture, which has resulted in the speedy oxidation, pitting, decay, production of crystals of vitriol, expansion, and final disintegration observed in such forms of pyrites.

A consideration of all the facts leads, I think, to the conclusion that the readiness to decompose in certain forms of pyrite is connected, only to a slight extent, with the nature of the surfaces of its crystals, and but in part with any visible internal peculiarities of structure. We may rather be inclined to infer a want of homogeneity in unstable pyrite, produced by an intimate intermixture with some unstable though invisible impurity, and analogy leads us to attribute the latter to the presence of some proportion of marcasite.

I have so far brought before you to-night the various peculiarities of texture revealed by the microscope in the crystals and nodular forms of the three pyrites, and have exhibited in miniature, in the slides, very nearly all the modes of decomposition by which these minerals are attacked. Some new facts of the same nature are yet to be described, which have been observed in the pyritiferous valves of the diatoms of the London clay, whose novel constitution was explained in 1881, by Messrs. Shrubsole and Kitton. They were found only in the lower portion of this stratum which underlies the London basin, often at a depth of 360 feet. Their numbers were so great as to be largely concerned in producing the distinct lamination of the clay, on whose planes they appeared as bright shining films. Several species of *Coscinodiscus*, *Triceratium*, *Arachnoidiscus*, *Trinacria*, etc., have been identified: 20 genera in all, and nearly 42 species. Count Castracane attributed the formation of their pyritiferous material to an electro-chemical process, and many others have looked upon it as a mere plating "deposited upon the siliceous skeleton, as in the electro-galvanic deposition of metals." F. Kitton, however, found that, on digestion in weak nitric acid, the entire frustule disappeared, and concluded that the silica had been replaced by a deposit of pyrites. He also noticed the occurrence of small globules of pyrites, $\frac{1}{2000}$ of an inch in diameter, resembling pewter balls or marbles.

I think you will agree with me, on an examination of several preparations of these diatoms here exhibited, that the following points of mineralogical interest are established :—

First. That the material referred to by all writers under the broad name of pyrites, consists substantially of the single mineral pyrite. To determine this point I searched for minute cavities in which the substance might have found opportunity to crystallize, and discovered not only minute drusy surfaces, but also little spherules covered by projecting crystals. The globules which Mr. Kitton detected, appear to have been round and smooth, probably concretionary. On those exhibited to-night may be seen triangular faces, which appear to belong to octahedra; these crystals must therefore consist of pyrite. This conclusion will be confirmed by a glance at the slide on which is mounted a crystalline crust from a specimen of fossil fruit, converted into pyrites, from the London clay at the Island of Sheppey. This drusy surface shows distinct, sharp octahedra of larger size, so that this crystalline form probably prevails in the pyrite crystals throughout the London clay.

Second. The true color of the pyrite films, when examined on a fresh cross-fracture, appears to be a grayish white. This indicates that the crystals are far from pure, probably mixed with a large proportion of marcasite.

Third. The incipient decomposition of the mineral is characteristic of the presence of marcasite, beginning with a golden-yellow tarnish within, and assuming a bronze color without. As the decay progresses, the valves become covered by a reddish film of iron oxide, and finally, the entire material passes into reddish-brown iron-ochre, sometimes blackened, as if by the intermixture of oxide of manganese. The mode of deep subterranean decomposition is, therefore, hepatic, and vitriolescence is never observed in these altered diatoms; although the latter form of decay attacks the nodules of pyrites lying nearer the surface in the London clay, at other points along the Thames, as at the Island of Sheppey.

In conclusion, I may state that I have found in the study of pyrites, many rich and interesting fields of investigation, in which the testimony of microscopical observation has proved indispensable.

THE CARPET-BEETLE.

BY THE REV. J. L. ZABRISKIE.

(*Read May 7th*, 1886.)

The Carpet-Beetle (*Anthrenus Scrophulariæ*, L.) is noted for the striking colors of the mature insect and the ravages of the larva upon our household goods. The insect was first noticed in the United States in 1872, although it has been known in Europe more than a century. It is now found spread over our country from the Atlantic coast to California. It was doubtless imported from Europe in infested carpets, and its distribution has been largely traced to a certain Boston Carpet-House.

The Beetle is about $\frac{1}{12}$th of an inch long, and prettily marked with regular patches of white and red upon a prevailing black-ground. It feeds upon the pollen of flowers, preferring species of Spiræa. And in our locality it will be found in infested houses in the latter part of April and throughout May, upon the windows, endeavoring to escape to the outer air to find its food.

The ravages are committed by the larva, which when fully grown are about $\frac{1}{4}$th of an inch in length, ovoid in form, and thickly covered with stout black bristles, causing it to appear like a little ball of black lint. It has been named very inappropriately the Buffalo Moth, perhaps from the shaggy appearance, and also from the fact that it was first noticed as injuring carpets at Buffalo, N. Y. In some parts of our country it has become so destructive that carpets have been dispensed with, and matting has been used in their stead. It has not been reported as injuring carpets in Europe, probably, it is said, because there, carpets are very generally taken up in summer and carefully stowed away. The larva prefers wool for its food, but greedily devours nearly all animal substances, especially furs, feathers, leather and entomological and animal collections.

The reports that it feeds occasionally on cotton goods and vegetable substances have not been confirmed, and it does not seem to affect silks. Carpet linings will protect the carpets from these pests. But where the carpet meets the base board of a room, they are sure to be found at work if they have the opportunity. Benzine is the best remedy known. A convenient vessel for applying it is a tin can, with a slender spout, and having a nozzle made from the point of an old silver pencil case. This will pour a stream about the size of a steel knitting-needle, and the benzine can be quickly and easily directed by it to the right place, as one making the application passes the can along the edge of the carpet. Benzine applied in this manner every fortnight in spring, and once a month throughout the year, will doubtless preserve a carpet on the floor, and also will preserve woolen goods, furs and feathers, when stowed in chests, where the stream of fluid can be poured upon the inner surfaces of the chests and not upon the goods themselves.

The scales here exhibited—white, red, and black, × 250—are from the back of the beetle, where they are larger and brighter than elsewhere, although they cover the entire surface of the insect.

This beetle belongs to the family Dermestidæ, of which over forty species are reported in this country.

With the imago and larva of the Carpet-Beetle some related species are exhibited, as *Anthrenus, varius*, Fab., a well-known museum pest, and the destructive Bacon-Beetle (*Dermestes lardarius*, L.); also, *Dermestes vulpinus*, Fab., and *Dermestes talpinus*, Mann. Also, two relatives, which are working with the Carpet-Beetle and which may become equally destructive : *Attagenus megatoma*, Fab., and *Trogoderma tarsalis*, Mels.

PROCEEDINGS.

MEETING OF MAY 7TH, 1886.

The President, the Rev. J. L. Zabriskie, in the chair.

Twenty-five persons present.

OBJECTS EXHIBITED.

1. Pyrrholite, iridescent hexagonal crystals; Elizabethtown, Canada.

2. Marcasite, with needles of white vitriol; from Trenton limestone, Jefferson County, New York.

3. Marcasite, with iridescent tarnish; Galena, Illinois.

4. Pyrite, with naturally polished faces; lines of growth parallel to cubical faces; Chili.

5. Pyrite (granular), minute cubes; New Jersey.

6. Pyrite, octahedra, iridescent with bands of color; Weehawken, New Jersey.

7. Limonite (Bog-Iron Ore), in pseudomorphous octahedra, after Pyrite; Weehawken, New Jersey.

8. Pyrite decaying in marble; Lee, Massachusetts.

9. Fibrous Pyrite, showing abundant fissures; Marsden's Diggings, Illinois.

10. Diatoms (*Coscinodiscus*), altered into Pyrite; London clay.

11. Pyrite, octahedra, from altered fossil fruit; London clay, Island of Sheppey.

The above objects were exhibited by Dr. A. A. JULIEN, in illustration of his paper on "the Microscopic Structure of Iron Pyrites."

12. Crystals of Oxalate of Calcium on Mycelium of fungus in decayed wood of *Pinus Strobus*, L: by P. H. DUDLEY.

13. The Carpet-Beetle (*Anthrenus scrophulariæ*, L.), with some related species: by Rev. J. L. ZABRISKIE.

14. Scales—white, red, and black—of *Anthrenus scrophulariæ*, L.: by Rev. J. L. ZABRISKIE.

15. Spiracles of *Platysamia cecropia:* by F. W. LEGGETT.

IRON PYRITES.

Dr. A. A. Julien read a paper on "The Microscopic Structure of Iron Pyrites."

CRYSTALS OF OXALATE OF CALCIUM.

Mr. Dudley: "These crystals were obtained from a specimen of Nicholson pavement laid some sixteen or seventeen years ago, in one of the streets of New York. They were found in abundance on the mycelium of fungus in the decayed wood. In examining almost any specimen of decayed wood, the crystals will be found in large numbers, but this is the only specimen in which I have found them upon the mycelium."

ANTHRENUS SCROPHULARIÆ.

The President read a paper on the "Carpet-Beetle (*Anthrenus scrophulariæ*, L.)."

Messrs. Arthur J. Wolf, M.D., and Edmund Tweedy, were elected active members of the Society.

MEETING OF MAY 21ST, 1886.

The President, the Rev. J. L. ZABRISKIE, in the chair.

Twenty-five persons present.

OBJECTS EXHIBITED.

1. Typhoid-fever Bacilli, from a pure culture, prepared by Dr. Prudden: by C. E. PELLEW.
2. Carbons made from paper, cotton, silk, bamboo, etc., used in incandescence electric lamps: by H. L. BREVOORT.
3. Transverse Section of Anther of Lilium: by W. H. MEAD.
4. Head of the Beetle *Eupholus Schœnherrii*: by B. BRAMAN.
5. Young of the Nine-Pronged Wheel-Bug (*Reduvius novenarius*, Say), just emerged from the egg; also egg-mass, showing about 120 eggs: by J. L. ZABRISKIE.
6. Section of Coal, showing vegetable structure: by F. W. LEGGETT.

TYPHOID-FEVER BACILLI.

Mr. Pellew reported to the Society some investigations recently made in regard to the Typhoid-fever bacillus, and in the course of his remarks exhibited several specimens of pure cultures of the bacilli, growing in gelatine tubes and upon potatoes. After giving a short sketch of the previous history of the subject, Mr. Pellew said: "Typhoid fever has long been recognized as peculiarly a germ disease, and as early as 1871, observers began to find varieties of bacteria in the tissues of patients. In 1882, however, Eberth discovered in the spleen and other organs, characteristic colonies of short bacilli with rounded ends, and his observations were confirmed immediately by Dr. Robert Koch and other careful workers. It was not until 1883, however, after the introduction of the new methods of bacteria cultivation, that these bacilli were isolated and studied in pure cultures. This was done by Dr. Gaffky, in Wurtzburg. Gaffky's work ceased at this point, as he was unable to reproduce the disease in either mice, rabbits, guinea pigs, doves, chickens, calves, or monkeys, by inoculation with these pure cultures. During the past year Dr. Pfeiffer, of Uresbaden, announced that he had been able to isolate the bacilli from the excreta of typhoid-fever patients, thereby confirming previous ideas as to the cause of epidemics of the disease.

"Within a few months past Dr. E. Fraenkel and Dr. M. Simmonds, of Hamburg, have published a pamphlet[1] containing their experiments, which, if confirmed, will practically prove that these bacilli are the cause of the disease. They worked on over thirty fatal cases, in an epidemic in their city, and in twenty-five of these cases were able to isolate the typhoid bacilli. They also isolated these bacilli from the excreta, and made an elaborate series of inoculations with their pure cultures on mice, rabbits, and guinea pigs, and in quite a number of cases obtained positive results."

NINE-PRONGED WHEEL-BUG.

The President: "I exhibit a recently hatched specimen of the Nine-pronged Wheel-bug (*Reduvius novenarius*, Say). It belongs to the order Hemiptera, and the sub-order Heteroptera, of which the Squash bug is a familiar example. It receives its popular name from a singular crest, situated longitudinally on the back of the thorax of the mature insect, resembling an erect segment or a wheel, provided on its outer edge with nine projections like short spokes or cogs. This creature is an eminent assistant to the gardener and farmer. From the very moment of its birth, it employs its time in searching for noxious insects, which it destroys in great numbers. It is said, the adult must be handled with care, for with its powerful beak it is able to inflict a wound more painful than the sting of a hornet.

"In this young specimen it may be noticed, that the legs are long and stout, the tarsal claws well developed; the antennæ have the distal joints of an orange hue; the large beak is bent from the under side of the head towards the breast, and the general color of the insect is a deep black, excepting the abdomen, which is blood red, with conspicuous black spiracles on the sides of the abdominal rings.

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[1] Die Aetiologishe Bedeutung des Typhus Bacillus. Von Dr. E. Fraenkel und Dr. M. Simmonds. Hamburg & Leipzig: Leopold Voss, 1886.

"I also exhibit the egg-mass of the same insect. This comprises about 120 eggs, glued to the bark of a tree, resembling a collection of minute, slender, black jars standing upright and very near each other, each jar having a contracted neck, and a light-colored lid, the latter being ornamented with a horizontal fringe of projecting rays."

BROWNIAN MOVEMENT IN MILK.

Mr. Brevoort made some remarks on the Brownian movement in freshly-drawn human milk, stating that he had observed that the movement varied, being most active at the birth of the offspring, and diminishing in rapidity as time elapsed.

Mr. George E. Ashby was elected an active member of the Society.

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Le Microscope à l' Exposition Universelle d' Anvers; pp. 35. By Dr. Henri Van Heurck.

The Canadian Record of Science: Vol. II., No. 2 (April, 1886); pp. 72.

The Microscopical Bulletin and Science News: Vol. III., No. 2 (April, 1886); pp. 8.

Brooklyn Entomological Society. Entomologica Americana: Vol. II., No. 2 (May, 1886); pp. 24.

Indiana Medical Journal: Vol. IV., No. 10 (April, 1886); pp. 22.

National Druggist: Vol. VIII., No. 18 (April 30th, 1886); pp. 12. No. 19 (May 7th); pp. 12. No. 20 (May 14th); pp. 16. No. 21 (May 21st); pp. 12. No. 22 (May 28th); pp. 12.

Journal of Mycology: Vol. II., No. 5 (May, 1886); pp. 12.

The Naturalists' World: Vol. III., No. 29 (May, 1886); pp. 18.

North Staffordshire Naturalists' Field Club. Annual Report, 1885; pp. 135.

Anthony's Photographic Bulletin: Vol. XVII., No. 9 (May 8th, 1886); pp. 32. No. 10 (May 22d); pp. 36.

Smithsonian Institution. Annual Report of the Board of Regents for the year 1884, pp. 904.

Bulletin of the Torrey Botanical Club: Vol. XIII., No. 5 (May, 1886); pp. 20.

Comptes-Rendus des Séances de la Société Royale de Botanique de Belgique: April 10th, 1886; pp. 8.

The Electrician and Electrical Engineer: Vol. V., No. 53 (May, 1886); pp. 40.

The Microscope: Vol. VI., No. 5 (May, 1886); pp. 24.

The American Monthly Microscopical Journal: Vol. VII., No. 5 (May, 1886); pp. 20.

The Botanical Gazette: Vol. XI., No. 5 (May, 1886); pp. 24.

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Johns Hopkins University. Circulars: Vol. V., No. 47 (March, 1886); pp. 14. No. 49 (May); pp. 18. Studies from the Biological Laboratory: Vol. III., No. 6 (May, 1886); pp. 83.

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Algæ of Fresh Water, Provisional Key to Classification of (VIII): R. Hitchcock.
Am. Mon. Mic. Jour., VII. (1886), pp. 95–7.

Blood, Observations upon the, of *Limulus Polyphemus*, *Callinectes hastatus*, and a Species of Holothurian: W. H. Howell.
Studies Biol. Lab., Johns Hopkins Univ., III. (1886), pp. 267–87 (11 figs.).

Blood, On the so-called "New Element" of the, and its Relation to Coagulation: Geo. T. Kemp.
Studies Biol. Lab., Johns Hopkins Univ., III. (1886), pp. 293-349 (14 figs.).

Corn Mildew and Barberry Blight: Worthington G. Smith.
Sci.-Gos., 1886, pp. 103-5 (2 figs.).

Duct Formation in Chestnut Wood: P. H. Dudley.
Bul. Tor. Bot. Club, XIII. (1886), pp. 91–2.

Diatoms, On the Finer Structure of certain: E. M. Nelson, and G. C. Karop.
Jour. Quek. Mic. Club, II. (1886), pp. 269-71 (5 figs.).

Fine Adjustments, The Cam: Ephriam Cutter.
The Microscope, VI. (1886), pp. 101–4.

Focal Planes and Diatomic Images (Under title Microscopical Advances.—X): Dr. Royston-Pigott.
Eng. Mech., XLIII. (1886), pp. 247–8 (5 figs.).

Focal Planes, and their Measurement by the Focimeter (Under title Microscopical Advances.—IX): Dr. Royston-Pigott.
Eng. Mech., XLIII. (1886), pp. 203–4 (8 figs.).

Gamasus, On a New Species of: A. D. Michael.
Jour. Quek. Mic. Club, II. (1886), pp. 260–8 (18 figs.).

Infusoria, Notices of New Fresh-Water: Alfred C. Stokes.
Am. Mon. Mic. Jour., VII. (1886), pp. 81–6 (18 figs.).

Interpretation of Microscopic Images with High Powers, On the: E. M. Nelson.
Jour. Quek. Mic. Club, II. (1886), pp. 255–9.

Julus terrestris, The early development of: F. G. Heathcote.
Quar. Jour. Mic. Sci., XXVI. (1886), pp. 449–70 (33 figs.).

Leeches of Japan, The: C. O. Whitman.
Quar. Jour. Mic. Sci., XXVI. (1886), pp. 317–416 (71 figs.).

Live Box, Note on a New Form of: C. G. Dunning.
Jour. Quek. Mic. Club, II. (1886), pp. 249–51 (2 figs.).

Marine Collecting with the surface net, On : G. W. M. GILES.
Sci.-Gos., 1886, pp. 110–11.

Microscopical Research, Results of : CHARLES H. STOWELL.
The Microscope, VI. (1886), pp. 107–11.

Nemertea, Contributions to the Embryology of the : A. A. W. HUBRECHT.
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Photo-Micrography.—VI : R. HITCHCOCK.
Am. Mon. Mic. Jour., VII. (1886), pp. 92–5.

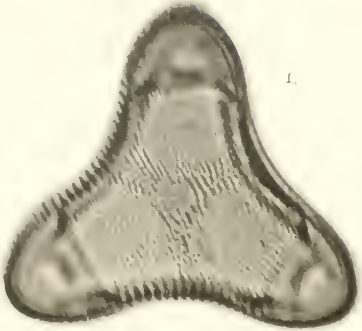
Proterospongia Pedicellata : ALFRED C. STOKES.
The Microscope, VI. (1886), pp. 105–6.

Schizophyta, The Pleomorphism of the : E. RAY LANKESTER.
Quar. Jour. Mic. Sci., XXVI. (1886), pp. 499–505.

Spongilla fragilis, On, Found in the Thames : B. W. PRIEST.
Jour. Quek. Mic. Club, II. (1886), pp. 252–4 (5 figs.).

Staining Tissues in Microscopy.—X. (HANS GIERKE, *Zeitschr. für. Wiss. Mic.*) *:* Translated by W. H. SEAMAN.
Am. Mon. Mic. Jour., VII. (1886), pp. 97–9.

Syllis, On the Structure of the so-called Glandular Ventricle (Drüsenmagen) of : WILLIAM A. HASWELL.
Quar. Jour. Mic. Sci., XXVI. (1886), pp. 471–80 (13 figs.).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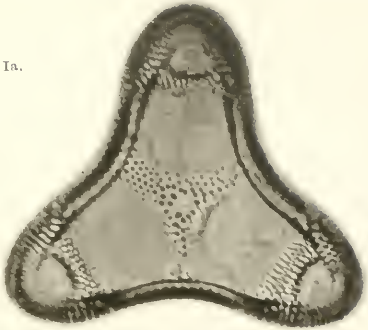
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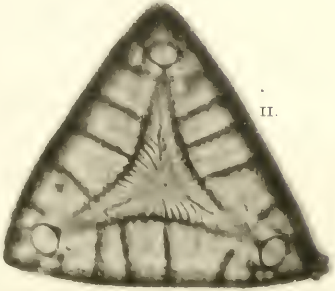
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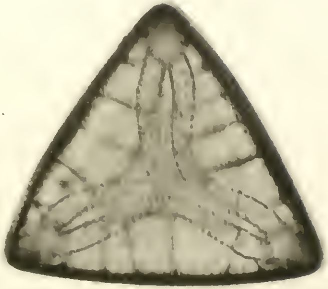
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N. Y. MIC. SOCIETY. PLATE 5.

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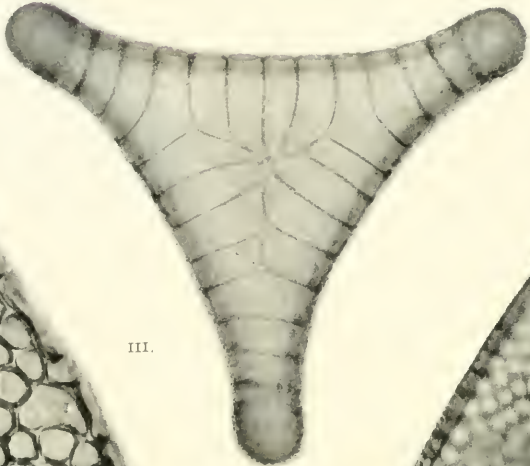

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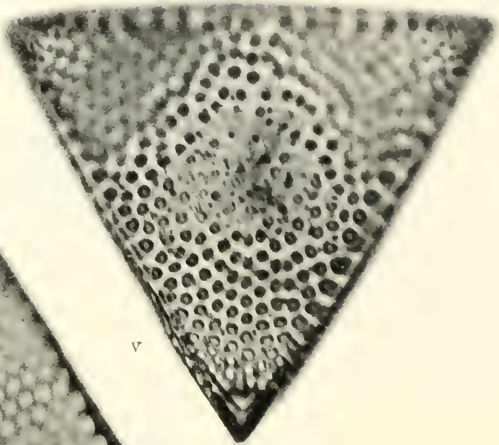

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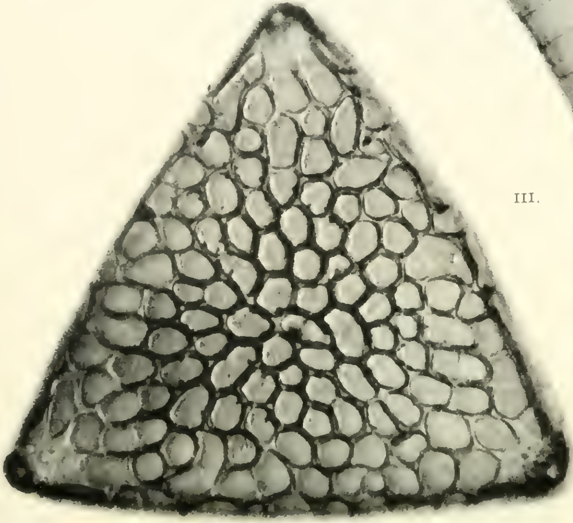

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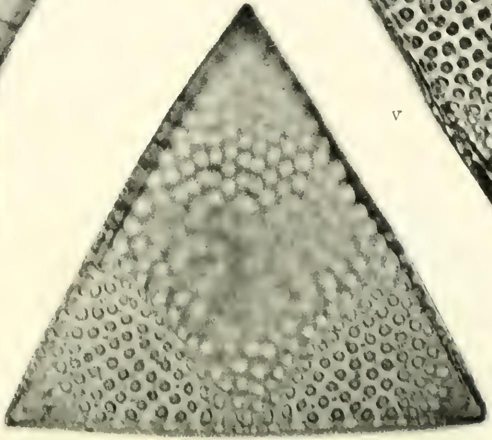

ARTOTYPE, E. BIERSTADT N. Y.

JOURNAL
OF THE
NEW-YORK MICROSCOPICAL SOCIETY.

VOL. II. JULY, 1886. No. 7.

LIVERWORTS.

BY THE REV. J. L. ZABRISKIE.

(*Read June 4th*, 1886.)

The Liverworts (*Hepaticæ*) are closely allied to the Mosses. And while it may be difficult to separate them from the Mosses by description, still a very slight acquaintance serves to distinguish them by sight.

They are divided into two main sections, with a nearly equal number of genera in each. The first section includes those genera whose vegetation is frondose ; *i. e.*, whose stem and leaves are confluent in a leaf-like mass. The second section includes those genera whose vegetation is foliaceous ; *i. e.*, whose leaves are distinct from the stem, as is the case with the Mosses.

I exhibit entire fruiting specimens, in vials of water, of two species of Liverworts, both belonging to the first, or frondose section.

1. The Brook-Liverwort (*Marchantia polymorpha*, L.). It frequents shady, moist places ; especially shady springs. The frond grows flat upon the wet soil, moss, &c. It is frequently from one to three inches in length, and one inch wide, usually forked at the growing end, of a bright green color, and has numerous rootlets underneath. The staminate, or male organs of reproduction, are little shield-like, lobed bodies on the upper surface of the frond.

Besides these there are sometimes also found, in the same situation, little cups, which contain buds, like minute green lenses, which are capable of originating new individuals. The pistilate, or female organs of reproduction, start from the edge of the frond, and ascend in a slender peduncle, sometimes two or three inches high. And at the summit of this there expand, in a wheel-like form, from nine to thirteen horizontal, lobed, green rays. Underneath these rays are found the spore-cases, enclosed in their involucres. These spore-cases are globular, depending from a slender pedicel, and rupturing by irregular lobes, when mature, to discharge their spores.

The Liverworts have curious organs, known as elaters, or springs. These are slender, lengthened cells, growing in the spore-cases, with the spores, and furnished inside with one or two spiral fibres. Their office is, by a sudden expansion, to violently project the spores from the spore-case, when the latter is ruptured at maturity.

2. The other species is the Small Liverwort (*Fimbriaria tenella*, Nees.). This was found growing abundantly on the ground along a hedge-row in an upland field at Nyack, N. Y. The frond is scarcely half an inch in length,—at first light-green, then turning purple. The peduncle of the pistilate receptacle is sometimes an inch and one-half long, and the receptacle at its summit is hemispherical, concave underneath, expanding at the margin into two to four pendent, bell-shaped involucres, each containing an ovoid spore-case. These spore-cases rupture, at maturity, by an irregular line near the horizontal circumference.

The spores and elaters of this second species are here exhibited under the microscope. These spores are nearly triangular, with a roughened outer coat, divided into irregular areas by numerous ridges. And the elaters are short and stout, each containing two spiral fibres.

THE STRUCTURE OF QUERCUS ALBA.

BY P. H. DUDLEY, C. E.

(*Read June* 18*th*, 1886.)

This wood possesses a structure not only of scientific interest, but one which renders it of economic value. The large ducts forming in the early spring growth are arranged in the inner portion of the ring, in one, two, and sometimes three quite distinct concentric rows. Surrounding these ducts are small tracheides, which form at the same time and have numerous small thin places on their sides ; their cross section is like that of the ducts, elliptical.

In the normal growth of an annual ring, hard dense fibres, in masses, begin to thicken the layer, soon after the ducts are formed, and generally continue through to the outer portion.

In wood of dense growth these fibres form the largest portion of the layer, and the wood has a high specific gravity, reaching in some specimens from .82 to .85 ; a cubic foot weighing 51 to 53 lbs., the ordinary weight being 42 to 45 lbs. These hard fibres are very small, being only .0006 to .0075 of an inch in diameter, and with the magnification of 100 diameters the lumen is just visible. I have not been able to find thin places in these fibres, though fluid communications may exist. These hard fibres do not occur as a complete zone, as the hard fibres do in several of the conifers, but are divided into radial layers or masses, if the ring be thick, by smaller ducts which diminish in size as they approach the exterior of the ring. These ducts are also surrounded by the small tracheides. The medullary rays are distributed through all classes of the fibres, the cells becoming flattened as they curve around the ducts. These masses of hard fibres are further subdivided by rows of cells running at right angles to the medullary rays, and which, in the alburnum, contain starch, except during the season of most active growth. Such abundant provision for the nourishment of the hard fibres indicates that only a limited circulation takes place in them, probably little more than is required for their development. Some have considered these fibres purely mechanical, and only added for strength. This prompts the inquiry, What additional strength and hardness does the oak require in growing, more than many other species of trees which grow of equal size and height and do not have similar fibres ? The *Liriodendron Tulipifera*, a tree of even more stately dimensions and broader leaf, has a series of ducts interspersed entirely through the annual layer, but has no hard fibres, and has only about one-half the specific gravity of the oak.

The climatic conditions have much to do with the growth of the hard fibres in the oak, for in some seasons the same tree will only have a few in the annual rings. This lack of hard fibres is noticeable in the timber which now comes to market ; timber which contained more and which was, therefore, of a superior quality, having been, apparently, exhausted. White oak, which has but a few of the hard fibres in the rings, is brash, and not as strong as that first described. In the transverse section, of which I exhibit a photo-micrograph, only the small medullary rays are seen, running through the masses of hard fibres. In other sections, the primary rays can be seen passing through the hard fibres. The starch-carrying cells, which also divide the hard fibres, at right angles to the medullary rays, are clearly indicated in the photo-micrograph. In the radial longitudinal section, the medullary rays and the exterior and interior of one of the ducts can be seen ; the latter are filled with tissue, and are never empty ; the section also shows hard, dense fibres, also, the interspersed starch-carrying cells.

In the tangential section, can be seen the end of one of the large primary bundles of medullary rays, also, those of the single rows, the characteristic markings of the tracheides, and smaller ducts. The short cells are those which at one time contained starch.

STAMEN OF THE DEERBERRY.

(VACCINUM STAMINEUM, L.)

BY THE REV. J. L. ZABRISKIE.

(*Read June* 18*th*, 1886.)

This plant is related to the Cranberries and Huckleberries. There are fourteen species of *Vaccinium* in the Northern United States. This species is one of the Huckleberries, known popularly as the Deerberry, and sometimes as the Squaw-Huckleberry. It is a shrub, two or three feet high. The fruit is globular, one-half inch in diameter, of a greenish color, rather nauseous, although sweet to the taste, but possessing a most agreeable aroma, as of delicious apples.

Some time ago, I had a dozen of these berries, wrapped in paper and enclosed in a book-case. For several weeks, every time that book-case was opened the entire room was filled with the agreeable odor of the fruit.

The corolla of this species, instead of being an oblong tube, with terminal reverted lobes, as is common in the order, is open, bell-shaped, and greenish-white, or purplish. The style is slender, and about three times the length of the corolla. The stamens are ten, about twice the length of the corolla, standing in a close bundle around the style, and of a curious form. The filament of the stamen is a white strap, hairy, and having attached to the inner face two large, elliptical pouch-like anthers, each anther extending in a slender tube, opening at the extremity by four or five ornamented lanceolate lobes. Each anther, also, is furnished with a slender awn of about one-half the length of the anther tube, arising from the outer and upper portion of the pouch. The pair of awns, extending horizontally in opposite directions, out from the longitudinal axis of the stamen, and being of a sinuous form, resemble a pair of spreading ox-horns. The entire surface of the anthers, also, is very prettily ornamented by hexagonal cells, each surmounted in the centre by a slender prominent papilla.

FIVE SPECIES OF TRICERATIUM.

BY E. A. SCHULTZE.

Plates IV. and V.

The slides from which the five species of *Triceratium*, figured on Plates IV. and V., were taken, are the work of Prof. Thum, in Leipzig, and the frustules are selections from the Barbadoes material.

I am indebted to my friend H. L. Brevoort, for his kind assistance in the preparation of these plates, his camera having furnished the negatives, which were taken with a Wales $\frac{1}{12}$-inch, and a Spencer $\frac{1}{16}$-inch objective, respectively, and which show a magnification of about 650 diameters. So far, I am only able to identify one of the five species; viz., (II.) "*Entogonia marginata*," of which IIa. represents the same diatom taken under a different focus. This specimen will be found figured in A. Schmidt's Atlas, Plate 88, No. 6. The other four have been sent to A. Schmidt for identification, the result of which I shall communicate to the Society as soon as I hear from him. No. III. is, I believe, a new species. I can find no specimen among the 125 at my command with which it might be classed as a variety, on account of the peculiar markings. The interior network is an embossed and sharp structure, interwoven here and there with lines of exceeding fineness. No. IV. is, I think, a variety of *Triceratium venosum*, figured in Schmidt's Atlas, Plate 88, No. 12; while V. (Va. a different focus) appears to be a variety of "*Triceratium caelatum*," Schmidt's Atlas, plate 81, No. 19.

PROCEEDINGS.

Meeting of June 4th, 1886.

The President, the Rev. J. L. Zabriskie, in the chair.

Thirty-one persons present.

OBJECTS EXHIBITED.

1. Micrococci of Pyæmia—from Human Heart : by Charles E. Pellew.
2. Bacteria of Putrefaction—from Human Liver : by Charles E. Pellew.
3. Arranged Diatoms : by C. S. Shultz.
4. Photo-micrograph of transverse section of *Larix Americana :* by P. H. Dudley.
5. Fruiting specimens of Liverworts—*Marchantia polymorpha*, L. and *Fimbriaria tenella*, Nees.: by J. L. Zabriskie,
6. Coralline Limestone, from Northern Ohio : by E. B. Grove.

BACTERIA OF PUTREFACTION.

Mr. Pellew, in describing the preparations exhibited by him, said that the slide showing "Bacteria of Putrefaction" illustrated the care that must be taken when tissues are examined for specific bacteria. The preparation was a section of human liver in a case of typhoid fever. On double staining, quantities of bacteria appeared which did not, however, resemble typhoid bacilli, either in shape, size, or mode of grouping. On inquiry, it was ascertained that the organs had been left exposed some time before immersing in alcohol, hence they were quite honeycombed by these putrefactive bacteria of all sorts.

LIVERWORTS.

The President read a paper on Liverworts, in explanation of the specimens exhibited by him.

Mr. Briggs presented to the Society fourteen slides of mica, prepared for use with the polariscope. On motion the thanks of the Society were tendered to the donor.

MEETING OF JUNE 18TH, 1886.

The President, the Rev. J. L. ZABRISKIE, in the chair.

Thirty-two persons present.

OBJECTS EXHIBITED.

1. *Tetraspora cylindrica*, two slides: by P. H. DUDLEY.

2. Section of *Quercus alba*: by P. H. DUDLEY.

3. Photo-micrographs of transverse, tangential, and radial sections of *Quercus alba*: by P. H. DUDLEY.

4. Pond-life: by C. S. SHULTZ.

5. Crystallized Gold from Ontario Mine, Colorado: by G. F. KUNZ.

6. Markings on Hydrolites from Thomaston, Georgia: by G. F. KUNZ.

7. Bacteria lactis from Human Milk, and Culture Tube of same: by W. H. BATES, M. D.

8. Five species of *Triceratium* from Barbadoes material; mounted by Prof. ED. THUM, Leipzig: by E. A. SCHULTZE.

9. Fore-wing of the bombycid moth *Utetheisa bella*, L.: by B. BRAMAN.

10. Anthers of the Deerberry (*Vaccinium stamineum*, L.): by J. L. ZABRISKIE.

11. *Hydrodictyon utriculatum*: by W. G. DE WITT.

STRUCTURE OF QUERCUS ALBA.

Mr. Dudley read a paper on the "Structure of *Quercus Alba*," illustrated by prepared sections and photo-micrographs.

TRICERATIUM.

Mr. E. A. Schultze exhibited five slides prepared by Prof. Thum, of Leipzig, showing as many species of *Triceratium* obtained from Barbadoes material, some of which he had been unable to identify.

[Plates containing photo-micrographs of the species exhibited, with a description of the same, will be found in this number of the Journal.]

STAMEN OF THE DEERBERRY.

The President read a paper on the Stamen of the Deerberry, illustrating the same by drawings on the black-board.

Mr. Sereno N. Ayres, of Jamestown, N. Y., was present at the meeting, and exhibited a number of micro-photographs prepared by him.

On motion, the Society adjourned to meet the first Friday in October.

PUBLICATIONS RECEIVED.

Proceedings and Transactions of the Natural History Society of Glasgow: Vol. I., New Ser., Pt. II. (1884–5); pp. 325. Index to Proceedings, Vols. I. to V. (1851-1883); pp. 67.

Brooklyn Entomological Society. Entomologica Americana: Vol. II., No. 3 (June, 1886); pp. 20.

The Naturalist's World: Vol. III., No. 30 (June, 1886); pp. 20.

The Botanical Gazette: Vol. XI., No. 6 (June, 1886); pp. 32.

The Microscope: Vol. VI., No. 6 (June, 1886); pp. 22.

The American Monthly Microscopical Journal: Vol. VII., No. 6 (June, 1886); pp. 20.

Bulletin of the Torrey Botanical Club: Vol. XIII., No. 6 (June, 1886); pp. 16.

Peabody Academy of Science. Eighteenth (1885) Annual Report; pp. 30.

Journal of Mycology: Vol. II., No. 6 (June, 1886); pp. 12.

Mineralogical Notes; pp. 22. By George F. Kunz.

Proceedings of the Colorado Scientific Society: Vol. II., Pt. I. (1885); pp. 36.

Bulletin of the Washburn College Laboratory of Natural History: Vol. I., No. 5 (May, 1886); pp. 20.

Anthony's Photographic Bulletin: Vol XVII., No. 11 (June 12th, 1886); pp. 36. No. 12 (June 26th); pp. 32.

Indiana Medical Journal: Vol IV., No. 11 (May, 1886); pp. 22. No. 12 (June); pp. 22.

The Microscopical Bulletin and Science News: Vol. III., No. 3 (June, 1886); pp. 8.

The Hoosier Naturalist: Vol. I., No. 11 (June, 1886); pp. 13.

National Druggist: Vol. VIII., No. 23 (June 4th, 1886); pp. 12. No. 24 (June 11th); pp. 18. No. 25 (June 18th); pp. 12 No. 26 (June 25th); pp. 16.

The Electrician and Electrical Engineer: Vol. V., No. 54 (June, 1886); pp. 40.

Journal of the Royal Microscopical Society: Ser. II., Vol. VI., Pt. 3 (June, 1886): pp. 184.

Nottingham Naturalists's Society. Transactions and Thirty-third (1885) Annual Report; pp. 43.

Transactions of Vassar Brothers Institute (Poughkeepsie, N. Y.) and its Scientific Section: Vol. III. Pt. 1 (1884–1885); pp. 216.

Johns Hopkins University, Baltimore, Md. Studies from the Biological Laboratory: Vol. III., No. 7 (June, 1886); pp. 51. Circulars: Vol. V., No. 50 (June, 1886); pp. 12.

Proceedings of the Natural Science Association, of Staten Island: May 8th and June 12th, 1886; pp. 2.

Comptes-Rendus des Séances de la Société Royale de Botanique de Belgique: May 2d, 1886; pp. 13.

Monatsblätter des Wissenschaftlichen Club in Wien: Vol. VII., No. 8 (May 15th, 1886); pp. 16.

INDEX TO ARTICLES OF INTEREST TO MICROSCOPISTS WHICH HAVE RECENTLY APPEARED IN OTHER JOURNALS.

Acarus, Upon the Life-history of an, one stage whereof is known as *Labidophorus talpæ*, Kramer; and upon an unrecorded species of *Disparipes*: A. D. MICHAEL.
Jour. Roy. Mic. Soc., VI. (1886), pp. 377–90 (23 figs.).

Algo-Lichen Hypothesis, A Résumé of the: T. H. KNOWLTON.
Am. Mon. Mic. Jour., VII. (1886), pp. 101–5.

Animal Parasites, Chapters on (No. II): W. A. HYSLOP.
Sci.-Gos., 1886, pp. 132–4 (10 figs.).

Balanoglossus Kowalevskii, Continued Account of the Later Stages in the Development of, and of the Morphology of the Enteropneusta: WILLIAM BATESON.
Quar. Jour. Mic. Sci., XXVI. (1886), pp. 511–33 (126 figs.).

Blood Corpuscles of Mammals, Measurements of: A. WATERHOUSE.
The Microscope, VI. (1886), pp. 97–101.

Cell Researches, Carnoy's: ARTHUR BOLLES LEE.
Quar. Jour. Mic. Sci., XXVI. (1886), pp. 481–97 (20 figs.).

Chilodon, Food-habit of a: ALFRED C. STOKES.
The Microscope, VI. (1886), pp. 121–4.

Chordata, The Ancestry of the: WILLIAM BATESON.
Quar. Jour. Mic. Sci., XXVI. (1886), pp. 535–71.

Desmidieæ, Key to the: ALFRED C. STOKES.
Am. Mon. Mic. Jour., VII. (1886), pp. 109–14.

Diatomic Beading and Images (Under title Microscopical Advances.—XI.): DR. ROYSTON-PIGGOT.
Eng. Mech., XLIII. (1886), pp. 313–4 (7 figs.).

Diatoms, The Resolution of, whose Striæ are of Unequal Fineness. EDWARD M. NELSON.
Eng. Mech., XLIII. (1886), p. 328.

Disparipes, an unrecorded species of: See Acarus.

Foraminifera, On the Collection and Method of Studying: J. M. FLINT.
Am. Mon. Mic. Jour., VII. (1886), pp. 105–8.

Fungus Hunting in Spring.—II.: W. B. GROVE.
Mid. Nat., IX. (1886), pp. 164–7.

Histological Examination, The Preparation of the Eye for: JAMES W. BARRETT.
Quar. Jour. Mic. Sci., XXVI. (1886), pp. 607–21.

Human Skin, Structure of the: CHARLES S. MINOT.
Am. Nat., XX. (1886), pp. 575–8 (2 figs.).

Labidophorus talpæ, Kramer. See Acarus.

Marine Collecting with the surface-net, On: G. W. M. GILES.
Sci.-Gos., 1886, pp. 121–2.

Micrococcus Pasteuri (Sternberg), On: G. M. STERNBERG.
Jour. Roy. Mic. Soc., VI. (1886), pp. 391–6 (6 figs.).

Microbe of Rabies, The: G. F. DOWDESWELL.
Eng. Mech., XLIII. (1866), p. 343.

Newt (*Triton cristatus*), Notes on the Development of the: ALICE JOHNSON and LILIAN SHELDON.
Quar. Jour. Mic. Sci., XXVI. (1886), pp. 573–89 (38 figs.).

Neurenteric Canal in Rana, Note on the Presence of a: HERBERT E. DURHAM.
Quar. Jour. Mic. Sci., XXVI. (1886', pp. 509–10 (6 figs.).

Oogenesis, Recent Researches on: ARTHUR THOMPSON.
Quar, Jour. Mic. Sci., XXVI. (1886), pp. 591–606.

Pleurosigma angulatum, What is the True Cause of the Dotted Appearance on the: J. B. DANCER.
Eng. Mech., XLIII. (1866), p. 320.

Pleurosigma angulatum, The Interpretation of the Six Spectra of: EDWARD M. NELSON.
Eng. Mech., XLIII. (1886), pp. 337–8 (5 figs.).

Polarizing Prism, New: C. D. AHRENS.
Jour. Roy. Mic. Soc., VI. (1886), pp. 397–8 (1 fig.).

Thalassema, Life-History of: H. W. CONN.
Studies Biol. Lab., *Johns Hopkins Univ.*, III. (1886), pp. 351–401 (51 figs.).

Tadpoles of the Common Frog (*Rana temporaria*), On the Development of: CLARA KINGSFORD.
Sci. Gos., 1886, pp. 124–6 (6 figs.).

Teeth, Sections of: W. C. BRITTAN.
The Microscope, VI. (1886), pp. 128–9.

Triton cristatus, Development of: See Newt.

Vaucheria, Some Abnormal Forms of: DOUGLAS H. CAMPBELL.
Am. Nat., XX. (1886), pp. 552–3 (7 figs.).

JOURNAL

OF THE

NEW-YORK MICROSCOPICAL SOCIETY.

VOL. II. NOVEMBER, 1886. No. 8.

BACTERIA IN DRINKING-WATER.

BY CHARLES E. PELLEW, M. E.

(*Read March* 16*th*, 1886.)

The question of a supply of pure drinking-water has been a very important one for many hundreds of years. A commandment, and a very good one, among the ancient Egyptians was, "Thou shalt not pollute thy river-supply." The ancient Romans, as we know, drew their supply of pure water from great distances. Much attention was given during the middle ages to the problem of furnishing cities with good potable water, less, however, for private than for public uses. Within the last century the belief that diseases may be disseminated through the medium of polluted water, has attracted increased attention to methods of obtaining pure water for drinking purposes. Among the diseases so disseminated is typhoid fever. So cholera is supposed to be spread ; likewise, other contagious diseases. It is, therefore, important to the world at large as well as to scientific people, that means be devised whereby pure water can be distinguished from water which is impure.

The chemist was the first to attempt this by analyzing water after the simplest methods. A quantity of the water to be tested was evaporated to dryness, and the residue was found to consist partly of mineral matter—lime, potash, etc.; but the healthfulness or unhealthfulness of the water tested was not ascertained by this plan. The nitrogenous organic matter contained in the water was next considered the disease-producing element, and of late years the chemist has directed his analyses toward determining what proportion of this matter, particularly in the form of ammonia, the water examined by him contained.

In his investigations, the microscope, if used by him, was used simply as an adjunct. That instrument might show what algæ were present discoloring the water and giving off bad odors, but it was subordinated to the chemical analysis. Meantime, however, the study of bacteria, particularly of bacteria in water, began to occupy the attention of students, and when it was found that the nitrogen and ammonia discovered in water by the chemists were not the causes of diseases such as typhoid fever, the theory was advanced that those diseases were caused by bacteria germs; for example, typhoid fever by a typhoid fever germ, cholera by a cholera germ. Pasteur and Koch were relied upon as authority for such theories, and it was claimed that in Germany far better results could be obtained in the examination of water for impurities by means of the microscope than by any chemical analysis, upon the ground that the germs of disease, bacterial in their nature, were undiscoverable except through the microscope. Hence, the existence of bacteria in water, their propagation, functions and effects, have become questions of the utmost importance, more perhaps because of what has been said concerning them than of what has been done. As all the new processes of analyzing water by biological methods depend upon the cultivation of bacteria in water, a few words about bacteria in general may not be inappropriate.

The bacterium is the lowest of organic forms. Its place in nature is on the boundary between animal and vegetable life. Van Leuwenhock made it known to science two hundred years ago. In examining with a microscope the tartar from his teeth, he found it swarming with actively moving minute organisms. These were bacteria; and their number was as great in the mouth of every human being, so the discoverer thought, as the population of the habitable globe. At that time spontaneous generation was a subject of discussion, and the bacteria were studied with a view of elucidating it. Later, it was ascertained that these living forms abound in the atmosphere, and that they will not generate in preparations from which the air is excluded. Pasteur has demonstrated the impossibility of spontaneous generation. In his studies of atmospheric germs he worked among bacteria and separated them into classes. He also studied them in connection with disease. In this field of investigation the Germans are now the most advanced students.

Bacteria occur everywhere. They are supposed to live and grow in the water and in the soil, but their extreme minuteness and lightness permit them under various conditions to be carried into the atmosphere, so that, practically, they are everywhere. What sort of things are bacteria? What do they look like? These are difficult questions to answer. Observed singly they are translucent. They are simply very minute cells whose walls enclose a fluid substance. If magnified about ten million times they would look like white grapes. They have neither heads nor tails, and they are generally either round, rod-like or corkscrew shaped Certain varieties are so minute that the most powerful microscopes are required for their proper examination. *Bacterium termo* is only $\frac{1}{12000}$th of an inch in length. The means of locomotion possessed by some bacteria consist of flagella. These appendages have not been discovered on all kinds. The micrococci, as a rule, do not appear to move about. Bacteria proper multiply by fission. The cell elongates, and finally separates into two parts. Each of these parts subsequently elongates and divides in the same manner; and so on without limit. Fission takes place in some cases hourly. On the first day or two the increase is comparatively slow, but afterwards it becomes very rapid. A single *Bacterium termo* would, in twenty-four hours, produce of its kind sufficient to occupy the space of about $\frac{1}{1000}$th of an inch. In five days enough would be generated to fill the ocean, if the generations could find enough food for their support. In the yeast plant, multiplication takes place as follows: The cell puts forth a little bud which increases in size until it attains the dimensions of the parent cell, and then drops off and itself proceeds to develop buds in a similar manner. Some bacteria have a very curious way of continuing their existence under adverse circumstances—a very objectionable fact in the case of those forms which are inimical to the health of man. Generally, the bacteria perish when their food is exhausted; but some of them at such times curl up and remain quiescent until they are supplied with additional food. Then they revive. This process can be watched under the microscope. The bacterium, as its food becomes scanty, shrivels up, and a little bright spot shows itself. This is the spore. Around it the cell-wall of the bacterium contracts and becomes exceedingly hard and firm.

In this condition, the organism, though able to bear for a long time the heat of boiling water, neither grows nor multiplies. Nevertheless, upon the return of favorable conditions, the spore expands and resumes its power to multiply. For destroying bacteria the student pursues the following method : The solution containing them is boiled ten minutes. This kills the bacteria but not their spores. Next, the solution is put in a warm place and left there for two or three days, during which the spores develop into bacteria, and it is then subjected to boiling heat again. This process is repeated until all the spores have developed into bacteria and have in that form been destroyed. Steam or dry heat is equally efficacious for this purpose.

Certain substances have been found which destroy bacteria These we call disinfectants. Carbolic acid is one. In our laboratory we use corrosive sublimate of the strength of one part to a thousand. With this we wash our hands. It does not hurt the hands, but effectually destroys the bacteria. In this are washed also the implements used in experiments with bacteria.

Bacteria absorb their food through the cell-wall, and through the same passes out the rejected material. They feed on all animal and vegetable substances which decay, and from them eliminate the original elements of which those substances are composed. They separate the carbon, hydrogen, nitrogen and sulphur from dead animal tissue, sending off therefrom as carbonic acid and nitric acid the carbon and nitrogen. In the absence of bacteria the earth would be cumbered with things dead that once had lived. Bacteria, the yeast plant, mould plants, etc., are necessary to our existence. They ripen our cheeses, and through their agency the curd or cream of milk is transformed into cheese. They bleach linen and cotton. They combine the oxygen and nitrogen of the atmosphere. Without them there would be no gunpowder nor nitro-glycerine. They are supposed to have been largely instrumental in the production of coal, and in changing coal into petroleum. They are, perhaps, involved in the process of animal digestion.

But bacteria do not always perform welcome offices. Occasionally, products of certain of them bring disease and death to man. Sausage and other meats, containing such products, have destroyed human life. The disease called tuberculosis is supposed to be caused by a bacterial organism, which enters the lungs, multiplies, and occasions the wasting called consumption. The fact that bacteria have been found connected with some forms of disease would apparently indicate that those diseases are of bacterial origin, although it has not yet been fully determined whether the bacteria may not be merely the accompaniments of such diseases. Inoculation with the bacteria which are supposed to be the cause of a certain disease would seem to offer means for determining this question, but even this method of experiment is beset with difficulties. If, for example, a man were inoculated with the bacterium of, say, typhoid fever, satisfactory information might be the result. But men are not available for such purposes ; hence, resort is had to the inferior animals, some of which are not susceptible to the diseases of man. Definite results, therefore, are as yet unobtainable ; although Pasteur's experiments with splenic fever demonstrate, apparently, the truth that vaccination with the *Bacillus anthracis*, whose virulence has been weakened by successive cultivations, affords protection to certain animals from splenic fever. The hope is entertained that many kinds of disease may yet be avoided by means similar to those employed by Pasteur in the case just cited.

There are different theories as to the way in which vaccination protects. One is, that when a crop of bacteria enters the system they consume all the food necessary for their support which the system contains, leaving none for a second crop. Another is, that the bacteria introduced generate not only the poison which causes the illness for which they are introduced, but also a poison destructive of themselves. But, in my opinion, the theory generally accepted is, that the blood contains that which kills the bacteria. A curious feature of tuberculosis is, that a dweller in cities, say New York, affected with it, on removing to certain parts of the country, the Adirondack mountains, for example, can, by proper exercise and diet, practically recover from his ailment, although the bacteria which are supposed to cause that ailment may be present in his system all the time. But on his returning to his city home the disease resumes its ravages. This would indicate that the mountain air and the conditions under which the sick man lived in such air, so acted upon the blood as to enable it to resist the effects of the *Bacillus tuberculosis*—possibly, by driving the organism into recesses where it could do no harm.

In the study of bacteria a well-made microscope is essential—one having an accurately moving stage and a good substage condenser. The objectives should be a $\frac{1}{8}$th and $\frac{1}{12}$th of the first quality. Staining fluids are used, some for coloring the organisms and some for coloring the tissues containing them. A good way of studying them without staining is as follows: Put a drop of gelatine on a cover glass, touch the gelatine with the bacteria, and then place the cover, prepared surface under, over the depression in a hollow-centred slide. By this means their development can easily be watched. Much, however, is required besides mere observation of occasional individuals under the microscope. They must be studied in large quantities. Pasteur's method involved the use of liquid media, such as soup, bouillon, milk, and various chemical fluids. While much valuable work was done by this method, accurate results are more easily reached by the use of solid media, in which the German investigators are proficient. Potatoes and fruits were first made use of for this purpose. I have here to-night, on potatoes, specimens of *Micrococcus prodigiosus*. In one specimen the growth is in the shape of the letters C. F. C. The bacteria were planted yesterday. The *Micrococcus prodigiosus* has been the cause of considerable discussion. Its presence in bread gave rise in former times, to wonder and fear, and its mysterious appearance, as a blood-red I. H. S. on the holy wafers, through the agency of some shrewd priests, was looked upon by many devout laymen as miraculous. In preparing these media, care must be used to destroy such bacteria as may be already present. From a potato, the bad spots, also the "eyes," must be removed. Then the remainder should be placed for an hour or two in a bath of, say, corrosive sublimate. Next, it should be put into a steam sterilizer under which a flame keeps the water boiling furiously, forcing the steam through the grating, and cooking the potato resting upon it. The potato is then put into a moist chamber previously sterilized, and is therefore protected from atmospheric germs by coverings of filter paper kept saturated with the sublimate solution. The hand and the implements used in the operation should also be sterilized. To inoculate the potato, place upon it some of the bacteria to be studied, using therefor a needle or platinum wire sterilized by passage through a flame. The *prodigiosus* develops in about two days, and can be identified by its deep red color, which, as far as we know, is peculiar to this bacterium. Some bacteria are green, some are white, some are yellow, etc., and by means of their colors one kind can be distinguished from another.

An important step in advance was taken when Dr. Koch hardened, by the addition of gelatine, the bouillon and other transparent media in which he cultivated bacteria. I have here a culture so prepared. The transparency of the entire mass allows easy observation of the colors by which the different bacteria can be identified. Sometimes, instead of gelatine, isinglass or agar-agar is used. The gelatine or other hardening agent must be sterilized before it is used. Koch devised the method of culture in gelatine thinly spread on pieces of glass, which possesses many advantages. He also contrived a plan for counting bacteria, as follows: Place over the glass plate upon which is the gelatine containing bacteria, a plate of glass ruled to a scale in minute squares. The number found in three or four squares can be used for computing the sum total in a specified space. Uncertainty, however, attends methods of ascertaining the productiveness of bacteria, and for a variety of reasons. Some do not grow in gelatine, some live in blood-cells only; and while half a million of a certain species may, after cultivation, be found in the space of a cubic centimetre, perhaps another species with which the gelatine was simultaneously inoculated may not multiply at all in that medium, leaving us, as to the productiveness of that species, entirely in the dark. So, too, does uncertainty follow the study generally of these organisms. Some species will not live in air or in oxygen. Cultures under observation are very liable to become infected with atmospheric germs. The vessel used may not have been sterilized, the hand the knife, anything employed in manipulating during the process of cultivation, may convey outside bacteria to the culture, and render the experiment nugatory, or void of satisfactory results.

The bacteria found in drinking-water may or may not be harmless to man. They may be very abundant, yet not deleterious, or they may be few in number and may consist, in part, of the deadly cholera germ, or the germ of typhoid fever. When they resemble the poisonous varieties they must be separated from the others, isolated, cultivated, and not until after they have undergone long and careful study and experiment can judgment be pronounced as to the salubrity of the water in which they were found.

Compared with its vital importance, very few satisfactory results have yet been reached in the study of Bacteriology. But it is a new subject, and the keen intellects now pursuing it will doubtless before long illuminate many parts of it which are at present shrouded in uncertainty.

PROCEEDINGS.

Meeting of October 1st, 1886.

The President, the Rev. J. L. Zabriskie, in the chair.

Twenty-eight persons present.

OBJECTS EXHIBITED.

1. *Cladocarpus flexilis:* by H. W. Calef.
2. Gizzard of Cricket: by J. D. Hyatt.
3. Section of Chalcedony: by J. D. Hyatt.
4. Section of *Coscinodiscus:* by E. A. Schultze.
5. Diatoms (218 forms) from the newly discovered deposit at St. Peter, Hungary: by E. A. Schultze.
6. Crystals of Native Gold from California: by W. G. DeWitt.
7. Seeds of Common Carrot (*Daucus Carota*, L.): by W. E. Damon.
8. Stamen of Moth Mullein (*Verbascum Blattaria*, L.): by J. L. Zabriskie.
9. Ovary of Moth Mullein (*Verbascum Blattaria*, L.); transverse section: by J. L. Zabriskie.
10. Natural and Artificial Rubies: by G. F. Kunz.

A COVER-CARRIER FOR IMMERSION AND DRY LENSES.

Mr. Wales exhibited a non-adjustable 1-5th inch objective with a cover-carrier, or cap.

He said that the idea of affixing a cover-carrier to a lens occurred to him because of the fact that opticians are frequently held responsible for errors of the manipulator in the use of non-adjustable lenses—that a non-adjustable lens corrected for a ten-inch tube would sometimes be used on an eight-inch tube, and, this failing to produce good results, the optician would get the credit for making a poor lens.

Hence he had fitted a cover-glass to a cap made to screw on to the front cell, or fitting over the objective, and had adjusted and corrected the lens for that particular cover-glass, so that the objective could be plunged down into any fluid without injuring it, and would always be correct for a ten-inch tube without adjustment.

In using an oil-immersion lens with the cover-cap, a drop of oil is placed on the inside of the cover-glass, and the lens can be used in urine, blood, or other liquids.

The oil can be allowed to remain there if the lens is perfectly tight, saving time and trouble in repeated examinations of this kind. The cap also serves as a protection to the lens. It can be easily removed and cleansed at any time, and the cover-glass can be replaced if broken.

Mr. DeWitt said that he had used the objective and fitting exhibited by Mr. Wales, in the examination of pond-life in small aquaria, by plunging it down into the water as suggested by Mr. Wales, and had found it useful and convenient, in that it made possible the repeated examination of certain forms like *Vorticella*, *Lacinularia*, etc., without removal to the slide or live-box and without injury to the objective.

GIZZARD OF THE CRICKET.

Mr. Hyatt : " The gizzard of the cricket differs from that of the chicken in that the chicken swallows its food whole, or in large pieces, passing it first into the crop and from there into the gizzard, which is a powerful muscular organ. This is always stored with small gravel or rough stones, which, being compressed by the contraction of the muscular bands, grind up the food, which afterwards passes into the stomach. But the gizzard of the cricket is lined with very curious teeth, and does not contain gravel or pieces of stone. The food when swallowed is passed along to the crop in the same manner as in the chicken. There is first a small expansion, then follows another, which we may call the gizzard, and from that the food passes to the stomach. In this gizzard are bands running down from one side to the other, the space between being set with very curiously shaped teeth, which are pointed toward the centre. The compression of the muscular fibres of the gizzard upon these teeth grinds up the food."

STAMENS AND GLANDULAR HAIRS OF THE MOTH MULLEIN.

The President, in explanation of the objects exhibited by him, said: "The three species of Mullein common to the Northern United States are much inclined to hybridization. The specimen from which these exhibits were taken had the filaments of the stamens clothed with an abundant violet-colored wool, which is characteristic of *V. Blattaria ;* but it also had the entire surface abounding with whitish glandular hairs, which is characteristic of *V. Lychnitis*, L. The woolly fibres of the stamens are long, attenuated, with an enlarged, pear-shaped distal extremity.

"The glandular hairs are advantageously shown on a thin transverse section of the ovary. These hairs are so abundant that they project from the cuticle of such a thin section in the manner of the teeth of a cog-wheel. The hairs are comparatively short and stout, and composed of three or four cells, so as to resemble a turned column, or baluster, of an elegant pattern. The gland at the summit of each hair is in the form of a glassy globe about four times the diameter of the supporting hair ; and the globe is ornamented with a beautiful closely-fluted pattern which extends from the horizontal diameter to the point of support."

MEETING OF OCTOBER 15th, 1886.

The President, the Rev. J. L. Zabriskie, in the chair.

Twenty-five persons present.

OBJECTS EXHIBITED.

1. Section of fossil Palm (agatized) : by J. D. HYATT.
2. Section of Agate : by J. D. HYATT.
3. Section of Obsidian containing Microliths : by J. D. HYATT.
4. Bryozoa on frond of *Sargassum bacciferum* from the Gulf Stream : by W. E. DAMON.
5. *Hydractina echinata :* by F. W. LEGGETT.
6. Transverse section of Maize-Leaf with the fungus *Puccinia Sorghi*, Schw. : by J. L. ZABRISKIE.
7. Spores of *Puccinia Sorghi,* Schw : by J. L. ZABRISKIE.

BRYOZOA.

Mr. Damon : "Whoever sails through the Gulf Stream is sure to encounter extensive fields of the floating sea-weed called *Sargassum.* When closely examined it is seen to be laden with little spherical air-vessels which serve to float it. Many of these will be found to be completely enveloped in a lace-like calcareous case, a rare specimen of marine architecture, which remains entire even after the death of the colony of Bryozoa which formed it. An attempt has been made by an expert jeweller to copy this delicate structure, in gold, as an ornament ; but success was impossible—so fine and intricate was the model found to be.

"*Sargassum* is a rich field for the microscopist, being the habitat of many interesting creatures besides Bryozoa. Among these are myriads of minute, gorgeously-colored crustaceans, and many forms of the beautiful *Sertularia,* and a small fish which has a curious dorsal lock-hinged fin, and, being of the same color as the plant, is often overlooked by the collector."

Mr. Schultz said that he had been requested to present to the Society on behalf of Mr. Charles E. Alling, of Rochester, N. Y., a copy of a blank-book published by Mr. Alling, entitled "Microscopical Records," and containing suitable blanks for cataloguing and describing five hundred slides, with an index and space for recording and preserving Formulæ used in preparing specimens.

On motion, the thanks of the Society were extended to Mr. Alling.

Mr. Ludwig Riederer was elected an Active Member of the Society.

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JOURNAL

OF THE

NEW-YORK MICROSCOPICAL SOCIETY.

VOL. II. DECEMBER, 1886. No. 9.

THE LIFE OF A DIATOM.

BY PROF. SAMUEL LOCKWOOD, PH. D.

(*Read December 3d,* 1886.)

What word more mysterious than that little one, Life? And as for those other monosyllables, Light and Sound, the mind must open widely to take in the conception of them required by modern science. Forsooth, both light and sound are nonentities, since each is but the manifestation of a form and measure of motion. One is the experience of the beating upon the optic nerve of the waves of the infinitely subtile ether, and the other the experience of the billowy lashing of the greatly grosser air upon the auditory nerve. Let the retina be injured, and, though the ether waves still impinge, there is neither light nor color. Similarly, sound waves make no impression on the injured ear. And what may Madame Science not yet exact? We are bidden to regard Life as a nonentity—merely a mode of motion of some odic or vital force. And this force—but no one knows what that is. And yet what it does, or, more correctly, what comes of it, that appeals to our judgment: hence, its manifestations may be intelligible, the object of experience, and the subject of verification. And endowed with this force is the atomy called a diatom. Of diatoms, there are many genera. A very large genus, in the numbers of its species, is *Navicula*, whose *maxima* or giant species is *Navicula dactylus;* and, speaking roughly, if we could place side by side 8,000 of these, the giants of the diatoms, the line so made would not exceed an inch in length. Of the Lilliputians of this race, 12,000 placed side by side might fail to make a line an inch in length. And even these infinitesimals have their life activities and phenomena.

Of such an atomy it falls to us to narrate, as best we may, the life-history.

First, then, what does the name Diatom denote ? Literally, it means something cut through at even distances. The word was coined by the earlier naturalists, whose studies of these organisms seem to have been confined to those species which in the living state are found in series like a chain, broken nearly across in clean fractures, as if cut, at uniform distances along the chain. Sometimes they were called "brittleworts." This chain-like feature is shown in the species *Diatoma vulgare.* But as this peculiar habit is true of a very few species only, the name, Diatoms, given to these organisms, was not well chosen.

Second. Let us now look at the general form, or, rather, the typical structure of a diatom; for the variety of forms is very great. Indeed, in the production of this vast group, the Diatomaceæ, and its allied order the Desmidiaceæ, Nature seems to have set herself the task of showing how many symmetrical-geometrical forms she could devise between a straight line and a circle—between the hair-like *Nitzschia*, on the one hand, and the gorgeous *Arachnoidiscus*, a discoidal, circular-box-shaped diatom, on the other. There are forms quadrate, oblong, rhomboidal, triangular, arcuate, ellipsoidal, ovate, spiral. These may be set down as geometrical. Then there are shapes which bear more or less resemblance to well-known objects, as spatulas, boats, stars, bottles (*Amphoræ*), crosses, etc.; and many of the diatoms, surprising to add, are sculptured with designs too delicate, too ornate, for pencil to delineate or words to describe. Throughout this multiplicity of forms the family likeness is never entirely lost. The ordinary systematist can in every instance recognize the diatom.

As to the skeletal structure of a diatom : For illustration, here is a little oblong chest. You will notice that the lower part has a flange over which the upper part shuts. The interior has no compartments. Let us be a little technical, and instead of calling this a box, call it a cell. Now, suppose it to be covered with morocco, like my lady's jewel-case. This covering must be called a membrane, or epidermis. What is wood in our little casket is, in the diatom, silica. I do not state that I myself have seen the epidermal membrane. I simply say that accomplished microscopists aver that they have seen it. Besides, in science we often know more than we have learned through the medium of the eye. I have never seen, with the physical eye, the enclosing pellicle that sustains the sphericity of the dewdrop which enjewels the petals of the summer rose. Yet to the eye of reason it is visible. Then, is the dewdrop a cell? No, because, though the seat of the play of wonderful forces, it is not organic at all. It is without structure. Except that it is a fluid, it is like a pure quartz crystal, homogeneous throughout. Even the encasing pellicle differs from the enclosed contents only in this, that the molecules of water which compose it adhere to one another more closely and with greater tenacity than do the molecules within. As to the diatom, the film entirely invests each half of the little box, while within, according to a recent view, are two silicate layers, the one next to the film containing the pattern of the sculpture of the little box.

So, we have simplified our cell into a tiny box. Indeed, years ago, Prof. H. L. Smith described the diatom as a siliceous box in two halves; in some, such as the *Pinnularia*, one part slipping over the other, as the upper half of a pill box slips over the lower half; in others, the two halves simply touching, as in *Fragillaria*. As to the parts of this tiny box: The part exposed to view when we are looking at the line where the two valves touch, is the front view, just as when we look at the keyhole of a trunk we see the front of the trunk. But the trunk has a back, as well as a front; whereas, the diatom, somewhat anomalously, has its front all around. What we call the top and the bottom of the trunk, in the diatom we call the sides. It is observable, too, that the aspects of the two sides frequently differ.

Third. Let us now look inside this diatom casket, and, if possible, inspect its contents. It contains a glairy substance which we will call protoplasm. Much of this has passed through its differentiation. Some of it, however, is still but little more than unaltered life-stuff. The larger part is a yellowish-brown viscid matter. If we take a leaf from any ordinary plant of flowering rank, say a *Pelargonium*, we observe that the soft parts of the leaf are green, and this green matter the botanists call chlorophyl. Of this the uni-celled algæ, such as the green slime of our ponds, are chiefly composed. But when we come to the higher algæ, the so-called seaweeds, though some of these are green, the green ones are in the minority. Some are black, some are purple. Others are olive-colored, but the most beautiful are red. Hence, the word chlorophyl, applicable to the green substance only, was supplemented by the word endochrome, which indicates this substance in all its colors except green. Thus, so much of the protoplasm as is elaborated into this yellowish substance in the diatom, we call endochrome. In recent vegetable chemistry the coloring matter in each of the lower orders of plant life is regarded as a principle and has its chemical name. For example, the yellow-brown pigment in the diatom is called diatomine, and similarly of the rest. It is highly probable that this diatomine is chiefly iron with a little chlorophyl ; and that in some modified way chlorophyl, or leaf-green, as a protoplasmic form of nitrogen, is present to a greater or less extent in all of these plant substances. In them, Prof. H. L. Smith showed by spectrum analysis, long ago, indications of both chlorophyl and cellulose. So the little diatom, besides stocking its house with endochrome, eliminates and elaborates from the water, cellulose, silica, and iron. It also adjusts and fixes each particle of its coloring contents one by one in place, as does the artist in mosaic arrange the variously colored patterns of his work. Within the endochrome is a central spot which we may call the nucleus, around which appears a ring of dots, chromic-iron granules, each of which begins a line of unconnected dots or granules that reaches to the outer boundaries of the endochrome. And shall we doubt that within this diatom-cell the beautiful phenomenon of life-force, circulation, cyclosis, is active ? Some students of these tiny forms think that they have observed it.

Fourth. How does the diatom feed ? How take in its pabulum ? How it lays down or secretes the silica is conceivable, for we may regard it as an infiltration upon a pattern ; but whence the beautiful pattern, who can tell ? And by what vital alchemy does it take from the water the constituents of its endochrome of amber, of its walls of glass, and of its protecting membrane of pellucid keratose ? No one knows. But how it takes in its unelaborated pabulum, how the closed box permits food to enter, is a process which perhaps we can explain. Let us again observe the line of contact of the upper and lower parts of the diatom. This line is called the suture. It is a delicate membrane, and extends around the very middle of the outside of the endochrome. It prevents the endochrome from protruding, doing in this respect for the endochrome what the investing film does for the dewdrop. It does more ; it feeds, as well as protects. In the complicated system of man, physiologists recognize the play of what is called the osmotic force. After the food is digested, its nutrient principles are given to the blood. They are then distributed by the circulation and transfused through the walls of the veins. So all along the sutural line of the diatom a sort of endosmosis lets the food-bearing water pass into the cell. As already shown, some diatoms are elongated and others circular in shape. On the top of an elongated one we observe along its centre a line or canal with a break at the middle, where the line is interrupted by a vesicular space called a vacuole. The line has also a similar but smaller cavity at each end. These terminal vesicles, it has recently been stated, contain a fine sort of protoplasm which exercises an influence over the organism not unlike that exercised over certain of the desmids by the contents of their terminal vesicles. Whatever this may mean, the line and the vesicles are covered with a non-porous membrane, and the question which concerns us is this : Is the function of the membrane which covers these vacuoles and the median line osmotic, like the sutural membrane ? The discoidal diatoms do not have this central canal. In its place and performing the same function, is a series of cavities around their edges.

Fifth. How do the diatoms reproduce or continue their species ? I purposely left unmentioned a part of the skeleton known as the band or hoop. After a while, the membrane which we have called the sutural, becomes covered with a siliceous deposit which grows into a band or hoop reaching ultimately entirely around the diatoms in the sutural space between the two valves. Let us now return and consider the endochrome again. The endochrome in the diatom is surrounded by a tissue more highly organized than any other part of the cell contents. This tissue is cellulose. Now, inside of it and close to it is a thin layer of reserve protoplasm which encloses the endochrome and constitutes the formative layer. It is to all intents the "primordial utricle." It is the chemist and modeller of this tiny workshop, for it transforms the protoplasm into the cellulose which invests the mass and makes two diatoms out of one. The dividing process is as follows : The hoop or band widens and pushes apart the valves of the diatom and, having thus performed its office, is disposed of by absorption or by becoming ruptured and then dropping off, which latter is the usual way. The restriction of the hoop removed, the endochrome grows rapidly. A vital ferment becomes active in the entire mass, the cellulose rind disappears or undergoes a radical modification, and in the body of the endochrome constriction begins, by means of which the mass is cut through in the middle. Meantime, the process which produces for each part its cellulose film and its secretion of silica, goes on, and when absolute separation takes place the one diatom has become two. This is what is called cell-division. It is really a multiplication by division—a process only found in the arithmetic of nature.

But what becomes of the parent diatom ? You will notice that the new diatom carries off one-half of the parent cell or box. That is, one of the two is the mother valve, the other is the daughter valve. You will also observe that the daughter is the smaller. Though there are exceptions, yet this is really a general law. When these daughter valves become in turn mother valves, the old valves, then grandmothers, will die ; and the daughters of this second generation will be smaller than their mothers. Now, unless nature had some way of meeting this point, the species would, by gradual diminution of size, become extinct. We are all familiar with that phenomenon of old age in the human race called rejuvenation—a brightening of the failing faculties, as when grandmama gets her second sight. Something similar takes place, I think, in the diatom. The period is near when the entire individual must die. Then comes a spurt of the vital force, and nature sets up a mystic marriage. Two of the diatoms, we will call them old ones, come together, and the phenomenon of conjugation takes place. Each extrudes its endochrome, the two masses coalesce for the purpose, so to speak, of bequeathing their united substance to their posterity, the silicate encasing supervenes, and a diatom larger than either of those which came together is produced. And what about this enlarged individual ? The books, in language less pellucid than obscure, tell us that it is a sporangium —that it is now a different organism from what it was before and is destined to emit spores or seed-like bodies capable of starting fresh generations of its kind. Whether this sporangium, having cast its spores, then dies, or lives to start another round of those cell-divisions which beget the mother valves larger than the daughter valves, in a series constantly decreasing in size, I do not know.

Sixth. A word as to the movements of these little bodies : A *Navicula* in motion looks exactly like a two-prowed boat. It moves in the water in a straight line, pushing aside obstacles that lie in its path, until, for no apparent reason, it stops, then suddenly moves straight backward. As yet, this movement is a mystery. There is, at times, observable when the diatom is in motion, a white line or coma of light all round the tiny boat, which looks like the effect that would be caused by the oars of an infinitesimal trireme. But no microscopist has ever seen the oars of the diatom. *Bacillaria paradoxa* has motions more remarkable than mere progression and retrogression. These diatoms are associated in ribbon-like bands of tiny rods, each rod or frustule being an independent individual. "These frustules slide over each other in one direction until they are all but detached and then slide as far in the opposite direction." Their movements are apparently contrary to all known laws of motion. In some of their positions they look like a flight of stairs, in others, like fasces ; in some, not unlike the staves of a barrel, a spiral flight of stairs, &c. From such positions they will quickly fall back into the communal ribbon or band.

Seventh. The motions of the diatoms induced the belief among earlier observers that these organisms are of an animal nature, a notion which spectrum analysis, it seems to me, entirely sets aside. Ehrenberg believed that the pair of spots usually seen in a diatom, technically called the oil globules, were stomachs, and hence designated the order, Polygastrica. He defended this interpretation of the spots by stating that he had placed indigo in the water containing diatoms, portions of which he subsequently detected in these stomach-like places. Many of us remember the tradition which tells us that years ago the rosy-hued hydrangea when watered with indigo-water produced blue-colored flowers. The indigo experiment proved nothing in the case of the diatoms. They are simply plants, notwithstanding the fact that one of our British cousins has recently declared his belief in their animal nature.

Eighth. The diatoms hold no insignificant place in the economy of nature. Their siliceous skeletons, deposited on the bottoms of seas and estuaries in enormous quantities, have, in places, built up geological strata of considerable importance. These, having in some cases subsequently emerged, afford material for several industries, among them the manufacture of the polishing stone called Tripoli, and, singularly enough, the manufacture of the terrible explosive dynamite. In their living state, diatoms become food for a large number of animals: for example, oysters and other delicious bivalves; also, acalephs, which draw them into their stomachs in immense quantities and thrive and fatten upon them, and which in turn, thus rendered very acceptable, serve as food for the arctic whale.

NOTE.—The foregoing paper was followed by the exhibition of a large number of lantern slides, illustrative of the text, photographed by Prof. W. Stratford.

THE MAPLE LEAF-SCALE.

BY PROF. SAMUEL LOCKWOOD, PH. D.

(*Read November 5th*, 1886.)

In the month of October last, Mr. F. W. Devoe sent me a fragment of a maple leaf on which were several black, shiny scales. I recognized the scales as those of the fungus, *Rhytisma acerrimum*, which, to some extent, had, for several seasons, attacked the maple trees in the vicinity of my home at Freehold, New Jersey. This is a fungus which has, unfortunately, become too common. Its generic name is derived from a Greek word signifying a patch or darn. During the past summer, the fine maple trees for which Freehold is noted, were affected by this fungus to an extent almost apalling. On some trees scarcely a leaf was free from it, and upon each of some of the leaves were as many as ten of these unsightly black patches. One windy day the sidewalks presented a curious sight. They seemed to be sprinkled with tiny flakes of anthracite coal, an appearance caused by the falling of these patches of fungus from the dying leaves of the maples. This, be it said in passing, is an unusual occurrence, because nature has furnished this scale with means of secure attachment to the leaf, as it is really the *nidus* in which are stored the propagating parts of the fungus. The windy day mentioned, it is proper to say, was preceded by a night of severe frost.

Under a low power of the microscope, these black, shiny scales are seen to be composed of mycelia, or rootlets, cemented together in a scale-like form and so convoluted as to present an ornate appearance, a sculptured surface, not unlike that of the large dorsal scales of a sturgeon. The scale is upon the upper side of the leaf, where it rounds up somewhat like a shiny, black blister. It, so to speak, puckers up the leaf. Its under side is not black, and is, moreover, the true leaf structure. It is not a single membrane. It is composed of an upper and a lower skin, between which is contained the life-stuff out of which shall come the organs necessary for propagating its species. The elaboration of these organs takes place in winter, when the leaves are on the ground. There they are subject to not a few casualties, hence the need of a housing for the protection of the germinating process; and this protection is afforded by the black pellicle or blister. The housing is perfect. I tried in vain to dissolve some of this black substance in alcohol. Water softens it, but strengthens it, as it does the paper shell of the *Argonauta*—making it impenetrable except to the admission of what may be necessary in elaborating the organs within. Such being the house, what about the commissariat? Every one knows how generous is the supply of starch in a grain of corn, a supply on which the embryo plant depends for its nourishment. Now, inside this black vesicle is a white mass, a grumous substance. This is the life-stuff out of which, in this tiny laboratory, shut in from the winter's storms, nature will develop the organs necessary for the propagation of the species.

The fungologist speaks of *asci* and *sporidia*. And these terms have a preciseness of meaning which fully warrants their use. But it will serve our purpose if we speak of spores, and of the *ascus*, or little sac, as the spore-containing cell or cup. Now, in this mass of grume, begins the marvellous making up of the tiny cups, the *asci*, by the mysterious potter, Nature, who, for that purpose, uses the grume as clay. And in each tiny cup, before the warm spring has come, are developed eight vital little objects, each of which is a slender thread-like thing. These are the spores, or sporidia. Let one of them be sown on a maple leaf during a warm, murky day, and it will beget its kind. So it comes about that with the earliest summer sun-warmth, the black housing crust cracks open, and the little cups eject their sporidia and entrust them to the summer winds, which find lodgment for them in the trees.

FRUIT OF THE FUNGUS *UNCINULA FLEXUOSA*, PECK, ON LEAVES OF THE HORSE-CHESTNUT (*ÆSCULUS HIPPOCASTANUM*, L.).

BY THE REV. J. L. ZABRISKIE.

(*Read November 5th*, 1886.)

This fungus is of the family Ascomycetes, or sack-bearing fungi. It is one of the Blights, of which M. C. Cooke has described twenty-two species in his Hand-Book of British Fungi, and of which Prof. C. H. Peck mentions forty-eight species in two of his publications in 1872.

One characteristic of these Blights is, that the mycelium of the fungus, parasitic on living leaves of plants, is spread as a white film on the surface of the leaf. Some species occur on the under surface only, other species on both surfaces of leaves.

Another characteristic is, that the fruit of the fungus takes the form of a nearly spherical conceptacle, from .003 to .008 of an inch in diameter, usually of a dark color, and containing one or more spore-sacks, or sporangia, each sporangium containing two or more spores.

A third characteristic is, that each little sphere of the fruit is provided with from eight to forty or more appendages, which are glassy, generally colorless, as long as the diameter of the sphere, or occasionally in some species four times the length of that diameter, radiating from the spherical surface like the spokes of a wheel, usually, until maturity, lying flat upon the surface of the leaf, and furnished at the distal extremity with a form sometimes of elaborate ornamentation, which is an important point in the determination of species.

The fruit here exhibited is of the genus *Uncinula*, so named because the tips of the appendages are uncinate, or furnished with a little hook; and of the species *flexuosa*, so named because about one-half of the appendage, next to the hook, is flexuous, or wavy in outline, sometimes appearing to be twisted in the form of an auger.

This species is common in our section of the country on the under surface of the leaves of the Horse-Chestnut tree. The mycelium is so thin that it is not readily discernible. But the conceptacles when mature can be seen, on close inspection, without a lens, appearing as minute black specks, scattered on the surface of the leaf. The conceptacles of this species have from thirty to fifty appendages, are about .005 of an inch in diameter, and contain about eight sporangia, while the sporangia each contain eight spores.

PROCEEDINGS.

MEETING OF NOVEMBER 5TH, 1886.

The President, the Rev. J. L. Zabriskie, in the chair.

Thirty-three persons present.

OBJECTS EXHIBITED.

1. *Laomedea :* by F. W. LEGGETT.
2. *Sertularia pumila :* by F. W. LEGGETT.
3. Embryo Hermit-Crab : by F. W. LEGGETT.
4. *Aulacodiscus Thumii ;* very rare : by E. A. SCHULTZE.
5. *Lepidodiscus elegans :* by E. A. SCHULTZE.
6. Fruit of the fungus *Uncinula flexuosa*, Peck, from leaves of the Horse-Chestnut (*Æsculus Hippocastanum*, L.) : by J. L. ZABRISKIE.
7. Section of a Quartz crystal with cavities enclosing a fluid and a moving bubble : by J. D. HYATT.
8. Suction-Cups from a gigantic Cephalopod (*Architeuthis princeps*—Devil-Fish), showing their marginal serrated edge : by W. E. DAMON.

SUCTION-CUPS FROM DEVIL-FISH.

Mr. W. E. Damon : "The microscope shows the sharp saw-like teeth, hard as steel, with which the suction-cups are armed. The Devil-fish applies these cups, of which it has about two thousand, to its prey, and by a kind of half turn sinks the teeth into the flesh, and holds all fast. The cups are arranged in two rows along the inside edge of each of the ten arms of this formidable creature. The probable use of the front pair of arms, which are much longer than the others, is to reach out for food, and to secure, with the help of the suckers, an anchorage to rocks or to the sea-bottom during stormy weather. These creatures have also a powerful horny, hawk-like beak, with which they destroy anything that their arms may bring within its reach.

"The suction-cups under exhibition were taken from a Devil-fish which was caught in our northern seas and which measured thirty-eight feet from tip to tip of arms. We have evidence, from fragments of this animal which have been found in the stomach of the sperm whale, that there exist in the Pacific seas specimens many times larger than the one from which these suction-cups were taken."

LAOMEDEA, SERTULARIA PUMILA, AND EGGS OF THE HERMIT-CRAB.

Mr. F. W. Leggett: "Under the first microscope, I have placed a branch of *Laomedea* which was hardened in alcohol and mounted in glycerine. Some of the polypes are partially expanded as in life. Death overtook the creature while its tentacles were conveying food to its mouths. This zoophyte attaches itself to floating sea-grass, and a person not using a magnifying glass in looking at it might consider it an accumulation of shore filth. It is, however, exceedingly interesting, as the whole branch represents one family, each polype being one of its many mouths, which not only act as the collectors of food for the household, but are also the seat of the reproductive organs—for from them are shot into existence objects resembling Medusæ in appearance, the ova of which, subsequently developed, become in time *Laomedea*.

"Under the next microscope, I have placed a specimen of *Sertularia pumila*, prepared similarly to the *Laomedea*. This, also, was found attached to sea-grass. Unfortunately, the polypes died in their closed cells; but, as these are perfectly transparent, the inmates can be seen, in appearance looking like beautiful tassels.

"Under the third microscope is a cluster of the eggs of the Hermit-crab. The young in the eggs are well grown and ready to emerge. I have found these eggs fastened to the long hairs of the mother crab. I have also found them, in the same condition, attached to floating grass. Some authors say that the eggs remain fastened to the parent until they are able to 'paddle their own canoes.' I have here, in this bottle, some of the zoophytes I have just described, attached to weeds. There is in the bottle a snail-shell also, occupied by a Hermit-crab. To the shell is attached *Hydractinia*, a specimen of which I exhibited at the last meeting."

ROCK INCLUSIONS.

On this subject, Mr. Hyatt, who exhibited a section of quartz crystal, containing a cavity in which was a moving bubble, said that he did not know what the contents of the cavity were, and he thought considerable uncertainty existed as to the nature and formation of these cavities generally. Heat, he said, was usually thought to be involved in their production; but, he suggested, might it not be well to ask whether or not cold had any part in their formation? Would not a particle of frozen water, caught in quartz during the crystallization of the quartz, on subsequently melting leave a cavity with an air space similar to the specimen shown? As to the effects of heat on these inclusions, he said that the specimen present had been subjected to a temperature equal to that of boiling water without being in any way affected by it.

Mr. Van Brunt: "A number of rock inclusions, liquids containing bubbles, etc., were shown before the Academy of Sciences and afterwards by oversight left out of doors exposed to severe cold weather. On subsequent examination, several of the specimens were found to be split or cracked and their inclusions gone."

MEETING OF NOVEMBER 19TH, 1886.

The President, the Rev. J. L. Zabriskie, in the chair.

Twenty-four persons present.

The Code of By-Laws for the government of the Society, reported at the meeting of October 1st, 1886, was adopted, to go into effect immediately, and to take the place of the Constitution and By-Laws as they existed on the first day of October, 1886.

OBJECTS EXHIBITED.

1. *Pyrgodiscus armatus:* by E. A. SCHULTZE.
2. *Aulacodiscus Thumii:* by E. A. SCHULTZE.
3. *Caprella acuminifera;* female with eggs: by F. W. LEGGETT.
4. Fruit of the fungus *Microsphæria extensa*, C. & P., from leaves of the Pin-Oak (*Quercus palustris*, Du Roi.): by J. L. ZABRISKIE.

CAPRELLA ACUMINIFERA.

Mr. F. W. Leggett : "This singular crustacean, sometimes called the 'ghost-shrimp,' is pictured and described by Milne-Edwards in his great work published in Paris in 1837. Save in the Encyclopedia Britannica, I have been unable to find it described elsewhere. Milne-Edwards says it is an habitué of the shores of the English Channel. These animals are nest-builders. Some of their nests resemble those of birds, while others are merely tubes ; and they are constructed of wood, stones, and mud-clay, fastened together by a cement excreted by the animal.

"I have on the slide a male and female, the pouch of the female being filled with eggs, one of which has been forced out in the process of mounting. The male is larger than the female, and has a much larger claw. This is characteristic of the species. I found these specimens at Black Rock, Connecticut. Their houses were tubular, and had been built on sea-grass. It is said that these creatures are destructive to timber. For such destruction their sharp jaws seem to be well adapted."

FRUIT OF THE FUNGUS MICROSPHÆRIA EXTENSA.

The Rev. J. L. Zabriskie : "This fungus is one of the Blights, of which another species was exhibited at the last meeting. It is common in our region on the upper surface of the leaves of various oaks, as the Pin-Oak, the White Oak, and the Red Oak. The web-like mycelium of the fungus is quite durable on the leaf surface, giving the latter a dusty, soiled appearance. The spherical conceptacles are black at maturity, about .005 of an inch in diameter, each containing four sporangia or sacks, and each sporangium containing from four to eight spores.

"The appendages of this species are quite striking in appearance. They number from eight to sixteen. They radiate horizontally from the periphery of the conceptacle, are delicate, colorless except for a short distance near their origin, about four times as long as the diameter of the conceptacle, and are elaborately ornamented at the tip. The extremity of the appendage is from four to five times dichotomously branched ; *i.e.*, successively divided into two portions, and the pairs of ultimate divisions tend to take the form of the double volute of an Ionic column. These combinations of divisions at the extremities of the appendages lie nearly in a horizontal plane, with an approximately square outline, giving somewhat the appearance of the expanded foot of an animal, furnished with many claws. And it is probable that these structures serve one purpose of such feet. For it can be seen that when such a conceptacle is carried away from its native situation, these multitudes of little hooks would cause it to adhere to any suitable surface on which it might lodge.

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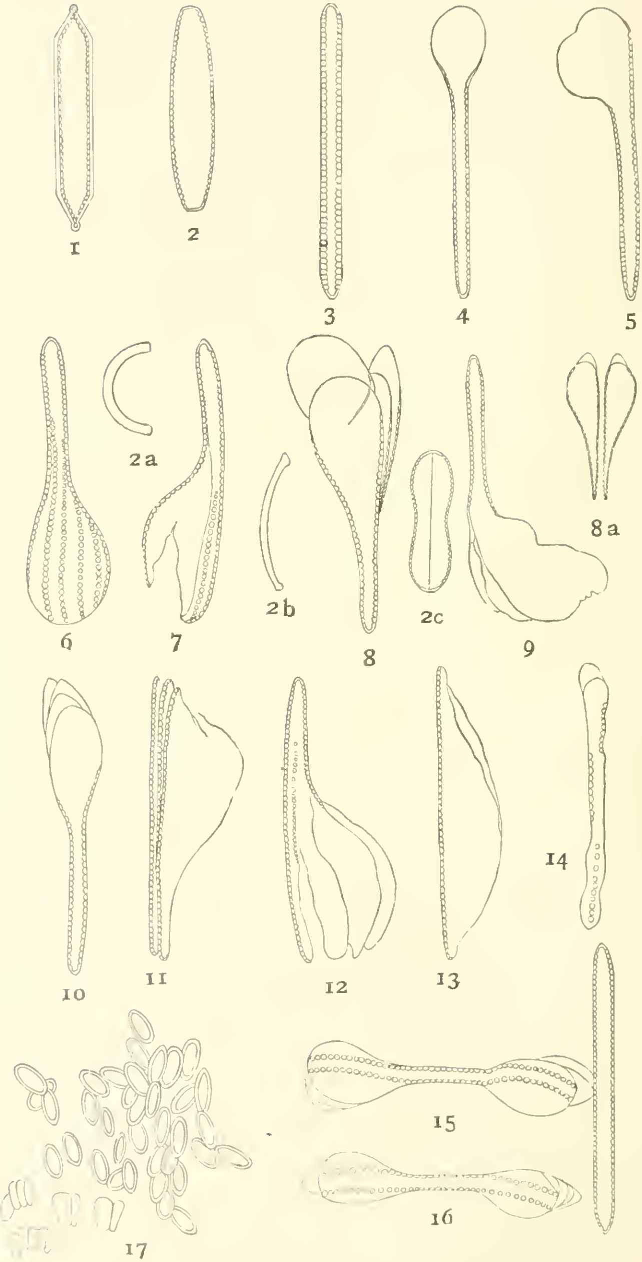
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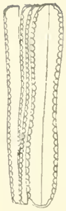

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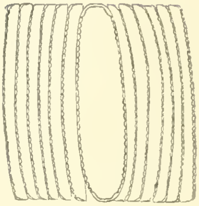

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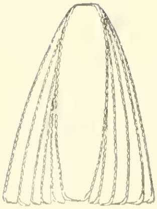

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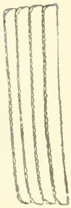

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SUPPLEMENTAL NUMBER.

JOURNAL

OF THE

NEW-YORK MICROSCOPICAL SOCIETY.

Vol. II. DECEMBER, 1886. No. 9a.

RAISING DIATOMS IN THE LABORATORY.

BY PROF. SAMUEL LOCKWOOD, PH. D.

(*Read December 17th,* 1886.)

Plates VI and VII.

April 1st, 1870, brought to a close the writer's residence of sixteen years at Keyport, New Jersey, on the south side of Raritan Bay. The place has long been noted for its oyster industry. From the oystermen there I sometimes obtained living marine objects which afforded incentives and opportunities for study. About to move to Freehold, fourteen miles inland, I besought these oystermen, friends of mine, not to forget to send me anything they found which they thought would interest me. To be prepared for the reception of such favors, I took with me a large demijohn of sea-water, so that an aquarium could be improvised. The water was taken at high tide from the Bay near the steamboat landing, and, owing to the mud held in suspension, it was very turbid. Trusting that the water would come out right after sedimentation, I put the vessel containing it in the cellar of my new house at Freehold. The black glass of the demijohn, its opaque encasing and its situation in a dark cellar, effectually prevented light from reaching its contents. This exclusion of light was, however, the result of mere chance, and not of design. The years rolled by, the sea-water was undisturbed and almost forgotten. "Out of sight, out of mind." No specimens came from my oystermen until the first week in December, 1882, when one of them sent me, "some oyster-moss just got from the Bay." It disappointed me, because it was a common object, *Sertularia* *argentea*, one of the Hydroidea. Though it was crisp and dry and apparently dead, I indulged the hope that it might have a spark of life, and so be revived. In truth, I had a pleasant memory of the delight experienced by me many years ago while watching with a hand-lens the little flower-like polypes which build up this graceful plant-like structure, catching their diminutive prey. So I improvised an aquarium in a specie-jar. Remembering the turbid condition of the water when I put it into the demijohn, I now poured it out with some misgiving. Barring a little sediment which became disseminated in the water but which soon settled, the water proved to be in excellent condition, and in it my pretty *Sertularia*, anchored to a bit of shell, rose like a fairy tree. Its very beauty increased my hope that it would revive. Two days passed without any sign of life in the hydroid, and then I became satisfied that it was dead. Still, as something attractive, the jar with its pretty object was permitted to keep its place in the window.

Some of the streamlets near my home are impregnated with iron oxide. A spring remarkable for its apparent purity yields a sparkling water, which, if allowed to stand in a glass a few hours, will deposit a yellow film of protoxide of iron. A few days after establishing my miniature aquarium, I noticed a yellowish-brown sediment at the bottom of the jar, and a similar but thinner deposit on the sides. Query : Was this an oxide of iron? A drop of the substance at the bottom was put under the microscope, and, to my astonishment, it proved to consist of diatoms. A scraping was taken from the film on the sides of the jar and examined, and this also was composed of diatoms. Their immense numbers showed that they had been bred in the jar. But what and where was the originating stock? I assumed that they were the product of diatoms parasitic on the *Sertularia*. The inference was at least natural. Science has, however, but little toleration for assumptions and inferences unless they are well supported, s › I set out to learn more about that oysterman's "specimen." I sought the man, and, failing to find him, saw his wife, from whom I got information in this wise : "That oyster-moss? Yes, I remember. You see, one day, as the Cap'n was smoking his pipe, he happened to look up at it on the wall, and, said he, 'Likely, Mr. Lockwood would admire that, as he used to like anything out o' the water, and it is a good while since I've given him anything.' So it was agreed to send it at first chance. Though when it come to the point, I did kind o' hate to take it down from granny's photo' which it had dressed up for a round year." This was indeed a damper, but happily not an extinguisher. It was now evident that the *Sertularia* had nothing to do with my crop of diatoms. Resolved, to get at the bottom of the mystery, if possible, I began a series of experiments, and designated this initial experience "Experiment No. 1." To the jar used I attached a label bearing the letter *A*. As the jar was really an aquarium, it had not been covered, but I now put on the top a piece of glass.

Again was the demijohn brought from the cellar, and a pint jar was nearly filled with the water a little roiled. This was labelled *B* and, covered with glass, was placed in the window beside *A*. This experiment No. 2 was started early in January, 1883. In about four weeks I detected a trace of sediment in the jar. A fertile drop of this was placed under the microscope, and lo! there they were, diatoms again. But this was only the beginning of experiment No. 2. In a few weeks the sediment at the bottom of the jar had thickened, as also had the film on the sides. In a word, this second crop of diatoms had become very abundant, and promised soon to quite equal in numbers the first one.

I was now firm in my belief that I was raising diatoms from the spores, although I could not yet say that this was proven. I next began a careful examination of the sediment in the demijohn, supposing that if there were any diatoms in the mud which caused the discoloration of the water when it was obtained from the Bay, be they now dead or alive, something should be learned from them. I found a number of forms, all, however, quite large in comparison with those bred in the jars. There were *Pleurosigma*, *Surirella*, a large *Navicula*, an *Achnanthes*, a *Coscinodiscus*, and several discoidal and other forms. They were, however, all dead, and, of them all, only one genus, and but one species, was represented among the diatoms in the breeding jars. True, in the sediment of the jars would be found, but very rarely, one of these dead forms which had been carried there in the agitated sediment from the demijohn.

This examination and comparison was entered as experiment No. 3. It seemed to furnish reasonable ground for the conviction that the diatoms I was raising had no originative connection with those diatoms in the old sediment.

It was the beginning of March. I had given much thought to this subject, and I now proceeded to make a crucial experiment—not that its failure would disprove anything, but that its success would, I thought, demonstrate the correctness of my conviction. This was set down as experiment No. 4. The demijohn was again resorted to, and from it into a jar similar to the preceding ones, water, equal in amount to what each of them contained, was passed through druggist's filtering paper. This done, the jar, labelled *C*, and covered with glass, was placed beside *B* in the window.

At this point in my experiments, I collected as well as I could all the diatomaceous material in jar *A*, my first experiment, put it in a small phial, which, together with a letter, I sent to Prof. H. L. Smith. In my letter, which was written and posted on the 12th of March, 1883, I did not mention that the diatoms had been raised in my study, but simply said that they had been obtained from water which came from Raritan Bay. I received from him a letter, also a mounted slide of the diatoms. This slide I have here under a microscope for your inspection. I have here also a number of slides of those diatoms mounted by myself. The Professor's letter stated that the slide contained three genera, *Nitzschia*, *Amphora*, and *Navicula ;* and that the *Nitzschiæ* were by far the most numerous, the *Amphoræ* next in number, and the *Naviculæ* least.

About the end of March, 1883, appeared that, to me, welcome sign, the yellowish-brown film on the bottom of jar *C*. Almost nervously I took a drop of it with a pipette, put it on a slide, and then placed the slide under the microscope, and what a sight ! The diatoms were there in immense numbers, many of them in lively motion. The *Nitzschiæ* and *Naviculæ* were of larger size than those in crops *A* and *B*. But this crop *C* yielded forms entirely new, and in numbers that would thrill a species-monger with delight. Of the symmetrical forms, five figures are given in the plate, 1, 2, 2^a, 2^b, 2^c. Figure 1 with its beaded borders and trim geometrical lines is an exquisite form, but is rare. Figure 2, a pretty, truncated ellipse, is of interest as constituting the nucleus in such nests or series of layers as are shown in Figures 19, 20, and 21. And, similarly, Figure 2c, an ellipse, constricted at the middle, is concerned with such layer-groupings as are indicated by Figure 18. These singular nests were very common, but I am not able to interpret them. Figure 2^a is an arcuate form of uniform thickness and with obtuse or rounded ends. There were many delicate rings, some broken, but most of them whole. These were hoops, and indicated frequent divisions, hence free propagation by the diatoms.

Figure 3, a front view, is the normal type of an eccentric group of asymmetrical forms, for from it have come all those *outré* and capricious forms, represented by Figures 4 to 16, inclusive. There seems to be no limit to their diversity. The figures represent but few of the large number of forms on the one slide, which slide I exhibit here. Figure 4, a spatulate form, shows the mildest or first aberrance from the type. Figure 5 suggests an alembic or retort, and so does Figure 6, which is excessively and capriciously ornate. Figure 7 has begun to divide, but the fission is on the wrong plane, being through the side instead of the front. It is also jaggedly irregular. In Figure 8, the division has stopped before going through the entire length. Four valves are noticeable, and if the division were normal and complete it would give two diatoms from the one in the usual way; but, not only is the division incomplete, it is also abnormal. Normally, the two new diatoms would have, each, one old or mother valve and one new or daughter valve, the daughter valves being usually shorter than the mother valves; whereas, in Figure 8, the two inside valves, the daughter valves, are, the one to the right disproportionately small, and the one to the left large even to deformity. Figure 8^a, which, like 2^c, is drawn to half the scale of the others, has developed into a pinna or mussel form and, thus being symmetrical, has made a complete division; still, the daughter valves are abnormal, being longer than the mother valves. Figure 9, so like a club-foot in appearance, is also dividing into similar monster forms. Figures 10, 11, 12, and 13, each show in a different way abortive efforts at propagating by division. Figure 14 has begun to divide, but is itself a monstrous deformity. 15 and 16 are dumb-bell shaped, double headed monsters in the act of dividing. The figure which is at right angles to them and touching Figure 15, and which differs so slightly from Figure 3, the initial form, seems to be the normal of the abnormals 15 and 16.

Is there not a law of the cosmic force in certain orders of living things whose activity, to use a mechanic's phrase, "works true" on bi-symmetrical lines? Surely, in the diatomaceæ this is apparent. Could it be, in these experiments of mine, that the diatom spores, by the long abeyance (fourteen years) of their life-force in an environment of darkness and quiescence, had lowered this force on some developmental line of the germ, and thus unbalanced it, so that these deformities are but the outcome of unkindly conditions?

In crops *A* and *B* I observed that the *Amphoræ* were often in groups or swarms. This I have noticed in the species when collected in the ordinary way. So in crop *C* this gregarious habit was seen to prevail. But, in addition to these groups of recognizable forms, I found swarms of minute bodies whose frustules were proved to be silicate by their indestructibility under the treatment of boiling nitric acid and of liquor potassæ. Figure 17 shows one of these swarms, but does not give their varying forms due to the progress of development. The individuals were sharp in outline and in shape varied from a broad oval, $\frac{1}{4000}$ in. long and $\frac{1}{4500}$ in. wide, to a narrow oval, $\frac{1}{4000}$ in. long and $\frac{1}{6000}$ in. wide. Some were elliptical, having a length of $\frac{1}{2400}$ in. and a width of $\frac{1}{6000}$ in. They are not circular in transverse section, but depressed, and, the more elliptical they are, the flatter they seem to be. Often, several lie together like a rouleau of coins. These embryos vary in size in the same manner as do the adult *Amphoræ*. Of these swarms, so numerous on the slides, I can give no interpretation other than that they are embryonal *Amphoræ*.

In scientific research, the intellectual is supposed to dominate the emotional. But, in the mind excited by novel discoveries, the latter will sometimes assert itself. Thus it was in my case; and during a spurt of joyful "gush" I took a naturalist friend into my confidence.

In May, 1883, I started my fifth experiment. A jar like those before described was used, and was marked *D*. The water in this instance was simply decanted from the demijohn. It seemed to me possible that there might be two kinds of spores, the swimming and the resting. If so, the agitation of the sediment in the demijohn must have given both kinds to the water used in the previous experiments. It was quite possible that, notwithstanding the care taken to exclude them in the present instance, some resting spores might have got into the jar, although very few could have done so.

In due time *D* produced a plentiful crop of diatoms. The normal species seen in the other jars were found in this one, but they were more robust. Besides them, were diatoms of a small oval form, and one of a slender build with a curve or bend and somewhat enlarged at each end, not unlike a rib (Figure 2^b). There was also a large number of very delicate *Nitzschiæ*. They were invisible in balsam, but quite distinct in a dry mount. Their tenuity entitles them to the specific name *attenuatissima*. Though this experiment gave novel results, it shed but little light on the question of motile and resting spores.

The month of May had come, and my official duties kept me much from home. The propagating jars were all left undisturbed in the study window until Fall, receiving meanwhile an occasional inspection. It occurred to me to try one more experiment. A fresh supply of water was procured from the Bay where the demijohn had been filled. A jar filled with this, marked *E*, was set in the window. In it was a small living frond of the sea-lettuce, *Ulva latissima*. Two months passed, during which not a diatom appeared. Evidently that water was sporeless.

The six experiments herein detailed were virtually completed, and it was now well on in January, 1884. Begun in December, 1882, the series had occupied my attention for a little over two years. For fourteen years had the water which I used been kept in a vessel closely corked and in complete darkness. Perhaps I ought to have published my work at the conclusion of the six experiments. I was urged to do so, but determined not to go into print until I had made a second series of experiments in order to correct or confirm the previous ones.

The old jars were guarded with zealous care, and occasionally examined until the Spring of 1886, when I began the new experiments. The first series of jars had the advantage of being kept in a window with a south-eastern exposure, thus receiving the stimulus of direct sunlight. In April, 1886, I changed my residence. Except during this removal, the jars had not been disturbed. Having put these old jars in a favorable place, I began five more experiments, using similar jars and lettering them as in the first series. This new series was commenced in May, 1886. In jar *A* roiled water was put, the demijohn having been purposely shaken. Jar *B* was supplied with water which I decanted carefully before shaking the demijohn. The water was a second time roiled and enough of it filtered to fill jar *C*, the filter paper at the start passing 100 drops per minute, but requiring 90 minutes to filter a pint. This jar *C* was then placed beside jar *B*. The filter used was laid aside and kept wet. I then shook the demijohn again, and took from it enough roiled water to fill two jars. This was carefully filtered, and the filters were kept. This filtered water was then boiled for twenty minutes and, when quite cool, enough to fill it was poured into jar *D*, which was then placed in the window by the side of *C*. In jar *E* the remainder of the cooled water was put, and in it were washed all the filter papers that had been used. Jar *E* was then set next to *D*. It should be noted that the jars of this series were subjected to a lower temperature than were those of the first series—a circumstance entirely unavoidable. For two weeks the tops of the jars were uncovered, thus exposing the water in them to the air, which, as microscopists know, is mischievously prolific of germs of confervæ and infusoriæ. However, this could not vitiate my work. Called away from home almost constantly by my official duties, I gave the jars no serious inspection until in the first part of the month of July. I then found in *A* a fine crop of diatoms, though they were not so numerous as they were in jar *A* of 1882. I observed with some surprise that the *Naviculæ* were now greatly in the ascendant. In fact, of the genera *Nitzschia* and *Amphora* there were very few representatives. I next examined *B*. To this jar I had looked for results equivalent to those of *D* in the first series, but could scarcely believe my eyes when, after many dips had been examined, I could find only one diatom, a *Navicula*. The film at the bottom of the jar was made up of one-celled confervæ. The water had been decanted so carefully that the spores, which doubtlessly lay on the sediment in the bottom of the demijohn, had not passed out with the water. Hence I infer that the spores are resting and not motile spores.

Jar *C* was next examined. Into this the roiled water had been filtered. It contained a rich crop of diatoms consisting almost wholly of *Naviculæ*, the *Nitzschiæ* and *Amphoræ* being rare. Many of the *Naviculæ* were in pairs, as if in conjunction. This fact made it possible to measure two at a time, which was done in quite a number of cases, with the surprising result that the pairs were all of exactly the same size. Some of these thus in opposition presented their sides to view, and some their fronts, thus enabling me to get the three dimensions, and the result showed entire uniformity of size, namely, length $\frac{1}{1200}$ in., thickness $\frac{1}{6000}$ in., and width $\frac{1}{12000}$ in. Could such remarkable agreement mean that these diatoms had all attained their full size, or could it mean arrest of growth at a certain point consequent upon exhaustion of pabulum? Hence arose a necessity for an analysis of the waters.

Jar *D*, into which was put the water that had been filtered and afterwards boiled, was next examined. It did not contain one diatom. The deposit in it was composed entirely of confervæ, the germs of which had entered from the air during the two weeks of exposure mentioned. This showed that the atmosphere had nothing to do with sowing diatom spores in my jars. Also, it proved in this case, that diatom seed could not survive the temperature of boiling water, though possessing a viability which survived an arrest or abeyance of the life-force through sixteen years of inertness in total darkness True it is, that the silicate frustules or skeletons of diatoms are found in the hot springs or geysers of the West, in waters of temperatures varying from 140° to 200° F.; but not a living diatom has been found therein, and, from our experiment just described, we must believe that none living ever will be found.

With large expectations I next examined jar *E*, the last of the series. During the course of these discoveries, I felt sure that the last experiment would be, like the last wine at the feast, the best, the most satisfactory. In this jar *E* had been rinsed the filter papers used in filtering three jars of water, and from such a generous sowing what might I not expect! Strange to say, the first dip of the sediment in the bottom yielded nothing but unicelled algæ. So did the second, and the third, and others that I made, until my disappointment at such unexpected results amounted to chagrin. Only an accasional *Navicula* was found, and still more rarely a forlorn *Amphora*; nevertheless, the great number of confervæ showed that good growing conditions were present in the jar. The few diatoms seen were of normal size and form, and appeared to be in the best condition. On reflection, I attached much importance to this negative result, for it impressed me with the conviction that the diatom seed was so exceedingly small that all of it, practically, passed through the filters used.

Through all these experiments excepting No. 1 and No. 2 of the first series, one is struck with the apparent discrepancies, differences in the amount of the several crops, in the species and in the sizes of individuals of the same species. The diatoms in experiments No. 1 and No. 2 of the first series, must, I think, be considered normal, and I give herewith a table of measurements, in parts of an inch, of individuals of the three genera contained in each of the jars used in those experiments.

	Nitzschia.		*Amphora.*		*Navicula.*	
	LONG.	THICK.	LONG.	THICK.	LONG.	THICK.
1.	$\frac{1}{414}$	$\frac{1}{6000}$	$\frac{1}{1333}$	$\frac{1}{4000}$	$\frac{1}{2400}$	$\frac{1}{6000}$
2.	$\frac{1}{414}$	$\frac{1}{6000}$	$\frac{1}{1333}$	$\frac{1}{3000}$	$\frac{1}{1500}$	$\frac{1}{6000}$
3.	$\frac{1}{414}$	$\frac{1}{6000}$	$\frac{1}{1333}$	$\frac{1}{4000}$	$\frac{1}{1500}$	$\frac{1}{6000}$
4.	$\frac{1}{414}$	$\frac{1}{4000}$	$\frac{1}{1090}$	$\frac{1}{2400}$	$\frac{1}{2400}$	$\frac{1}{9000}$
5.	$\frac{1}{430}$	$\frac{1}{6000}$	$\frac{1}{1333}$	$\frac{1}{4000}$	$\frac{1}{2575}$	$\frac{1}{6000}$
6.	$\frac{1}{480}$	$\frac{1}{6000}$	$\frac{1}{2000}$	$\frac{1}{4000}$	$\frac{1}{3000}$	$\frac{1}{6000}$
7.	$\frac{1}{414}$	$\frac{1}{4000}$	$\frac{1}{1333}$	$\frac{1}{3000}$	$\frac{1}{2400}$	$\frac{1}{6000}$
8.	$\frac{1}{414}$	$\frac{1}{6000}$	$\frac{1}{1200}$	$\frac{1}{3000}$	$\frac{1}{1500}$	$\frac{1}{5000}$
9.	$\frac{1}{480}$	$\frac{1}{6000}$	$\frac{1}{1712}$	$\frac{1}{4000}$	$\frac{1}{2575}$	$\frac{1}{6000}$
10.	$\frac{1}{430}$	$\frac{1}{4000}$	$\frac{1}{1090}$	$\frac{1}{3000}$	$\frac{1}{4000}$	$\frac{1}{9000}$
11.	$\frac{1}{430}$	$\frac{1}{4000}$	$\frac{1}{1333}$	$\frac{1}{3000}$	$\frac{1}{2575}$	$\frac{1}{12000}$
12.	$\frac{1}{430}$	$\frac{1}{6000}$	$\frac{1}{1090}$	$\frac{1}{2570}$	$\frac{1}{2400}$	$\frac{1}{9000}$
13.	$\frac{1}{430}$	$\frac{1}{6000}$	$\frac{1}{1500}$	$\frac{1}{4000}$	$\frac{1}{1500}$	$\frac{1}{6000}$
14.	$\frac{1}{430}$	$\frac{1}{6000}$	$\frac{1}{1250}$	$\frac{1}{5000}$	$\frac{1}{1090}$	$\frac{1}{4500}$
15.	$\frac{1}{430}$	$\frac{1}{6000}$	$\frac{1}{1333}$	$\frac{1}{3000}$	$\frac{1}{1500}$	$\frac{1}{6000}$
16.	$\frac{1}{414}$	$\frac{1}{6000}$	$\frac{1}{1090}$	$\frac{1}{3000}$	$\frac{1}{1200}$	$\frac{1}{6000}$
17.	$\frac{1}{414}$	$\frac{1}{4000}$	$\frac{1}{1333}$	$\frac{1}{4000}$	$\frac{1}{1333}$	$\frac{1}{6000}$
18.	$\frac{1}{414}$	$\frac{1}{6000}$	$\frac{1}{1333}$	$\frac{1}{4000}$	$\frac{1}{1500}$	$\frac{1}{4500}$
19.	$\frac{1}{430}$	$\frac{1}{6000}$	$\frac{1}{1333}$	$\frac{1}{3000}$	$\frac{1}{2000}$	$\frac{1}{9000}$
20.	$\frac{1}{480}$	$\frac{1}{6000}$	$\frac{1}{1090}$	$\frac{1}{2570}$	$\frac{1}{2400}$	$\frac{1}{9000}$

The *Navicula* column shows much diversity of sizes, and yet the diatoms whose measurements are there given were of the same species as those in jar *C* of the second series, which showed complete uniformity in size. As to the Figures 1, 2, and 3 in the plate, they measured respectively $\frac{1}{800}$ by $\frac{1}{9000}$, $\frac{1}{560}$ by $\frac{1}{3800}$ and $\frac{1}{430}$ by $\frac{1}{4000}$.

It is with regret that I allow this paper to go to press without containing a full determination of the species of the diatoms spoken of. For this determination I had depended upon Prof. H. L. Smith, but the serious accident which befel that eminent diatomist made it impossible for him to furnish the list.

RÉSUMÉ.

1. My experiment of December, 1882, the results of which I have confirmed by so many observations made since, demonstrates that diatoms originate in spores, or seed-like bodies.

2. These spores are exceedingly minute, passing easily through filter-paper.

3. They are probably resting spores not motile, and may be held in suspension awhile like the mineral matter in turbid water.

4. The viability of these spores is remarkable. The diatoms raised in the first series of experiments were from spores whose life-force had lain dormant in total darkness for thirteen or fourteen years ; those in the second series, for sixteen years.

5. The viability of some genera is greater than that of others. This is notable of *Navicula* in these experiments, and is consonant with the numerical lead of this genus in forms or so-called species.

6. Owing to the environment becoming abnormal, development may be rapid and erratic to a surprising degree, but upon aberrant and asymmetrical lines. Suppressed at some points, the life-energy is precociously active at others.

7. Diatoms have embryonal stages or forms, with silicate fronds.

8. As to kind and quantity, the crops are capricious and vary without apparent reasons.

9. As to the parentage or begetters of the spores in my experiments: They were not generated in the vessel which contained the water, but were begotten of sporangial mother cells in the Bay.

ANALYSIS OF THE WATER.

The fact that in one crop the diatoms of one species were all of the same size, caused me to supect that they had ceased to grow in consequence of having exhausted the silica in the water. So I submitted four one-pint bottles of the water to the skillful analyst Prof. Peter T. Austen, of Rutgers College, New Brunswick, N. J. These bottles were labelled *A*, *B*, *C*, and *D*, respectively. The first two contained water that had not been used in my experiments, *A* being from the large demijohn, *B* from the smaller one, the water in both having come from the same place in Raritan Bay ; but while the water in the smaller demijohn had been in my cellar not quite two years, that in the larger one had been there nearly seventeen years. Samples *C* and *D* were from the jars of the first series of experiments, which had been so fruitful of diatoms. To my surprise, the following was the report of the analyst :—

Amount of Silica in grains per gallon.

Sample *A*,	1.71
Sample *B*,	1.24
Sample *C*,	3.78
Sample *D*,	4.44

The Professor wrote me : "You will notice that the samples in which the samples have been grown are much richer in silica than the original water. This is probably because the water has stood for a long time in glass vessels and has hence dissolved silicates from the glass. It is probable that this silica is combined as silicate of soda or potash. Water has a very appreciable solvent action on glass, indeed, so much that in chemical analysis we have to correct the error introduced by the use of glass vessels. Without large samples and exhaustive analyses it is difficult to interpret these results. A possible hypothesis for the refusal of the diatoms to grow any longer may be that they only take up free (that is) uncombined silica, or, if they take the silica away from the base, the setting free of the base may leave the water more or less alkaline, which may possibly be detrimental to their development. It is very difficult in a case like this to get all the conditions."

It should be noted that the unused water in samples *A* and *B* had, so far as being in glass vessels is concerned, been all the time in darkness ; also, that *A*, from the larger demijohn, is richer in silica than is *B*. But *C* and *D* had been exposed nearly five years to daylight; hence, in my opinion, the solvent action of the water was, in *C* and *D*, more energetic than in the others, because of the photochemical stimulus of the solar light. When the quantity of the diatoms raised is considered, we are impressed with the elaborating and assimilating energy of these tiny organisms which use up and yet conserve so large an amount of silica.

EXPLANATION OF PLATES VI. AND VII.

The figures on the plate were drawn from a careful study of a single slide of material from jar *C*, of the first series. They are magnified 1600 diameters excepting 2^a, 2^b, 2^c, and 8^a, which are magnified about 800 diameters; and excepting also Figure 17, the individuals of which are magnified about 350 diameters. Only in Figure 2^c was I able to detect the median line, and in none could I find the central or the terminal vacuoles.

Figure 1. This beautiful form was very rare.

Figure 2. Not rare, and often found as the nucleus of a double nest of layers, as shown in Figures 19, 20, and 21, of the text.

Figures 3 to 16 inclusive. Figure 3 is a side view of the typical form from which the others are monstrous aberrants.

Figures 15 and 16. Dumb-bell forms, or wider aberrancies.

Figure 17. A swarm of embryonal *Amphoræ*, simply a diagram.

Figure 18. Shows one side of the nesting, of which 2^c is the nucleate centre.

Figures 19, 20, and 21, Nests, of which Figure 2 is the nucleus.

All these figures are described more fully in the text, where their exact magnitudes are also given.

I am indebted to my friend, Dr. Alfred C. Stokes, the infusorist, for the measurements given in this paper, and to his facile pencil for the drawings. The measurements were made with a Rogers micrometer eye-piece and a Fasoldt stage-plate, and the objective used was a Herbert R. Spencer homogeneous-immersion $\frac{1}{10}$ of N. A. 1.35.

A NOTE.

Under date April 6th, 1886, Dr. Alfred C. Stokes wrote me: "Do you have access to the Journal of the Royal Microscopical Society? I hope you do, but if you do not, the following from the December (1885) number may interest you. * * * It becomes more than interesting when taken in connection with your 'mysterious diatoms' experience; and your observation as a whole is much more remarkable and valuable than Mr. Kitton's. I wish you would publish it, although it may be somewhat incomplete. * * * I am sorry you did not publish your observations long ago and so have been the first to announce the discovery."

The article in the Royal Microscopical Society's Journal, which is taken from the Journal of the Quekett Club, in brief, says, that Mr. F. Kitton, observing a film on some water in his laboratory, found to his surprise that it was composed of *Achnanthes linearis.* He then filtered some of the same water and, in time, obtained from it another film made up of the same diatoms, although he burnt and decarbonized the filter-paper without finding any diatoms in it. My own discovery antedates Mr. Kitton's by more than two years, and I think it was at least a year before his discovery and when my first series of experiments had for some time been completed, that I made a verbal statement of the main facts at a meeting of the New-Jersey State Microscopical Society.

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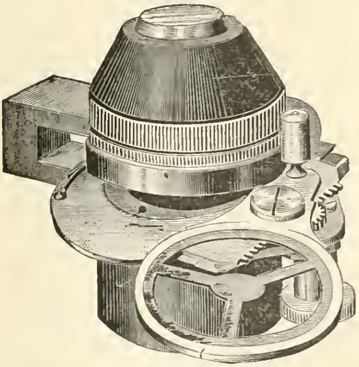

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I. Numerical Aperture Table.*

The "APERTURE" of an optical instrument indicates its greater or less capacity for receivi rays from the object and transmitting them to the image, and the aperture of a Microscope objective is therefore determined by the ratio between its focal length and the diameter of the emergent pencil at the plane of its emergence—that is, the utilized diameter of a single-lens objective or of the back lens of a compound objective.

This ratio is expressed for all media and in all cases by $n \sin u$, n being the refractive index of the medium and u the semi-angle of aperture. The value of $n \sin u$ for any particular case is the "*numerical aperture*" of the objective.

Numerical Aperture. ($n \sin u = a$.)	Angle of Aperture ($= 2u$.)			Illuminating Power. (a^2.)	Theoretical Resolving Power, in Lines to an Inch. ($\lambda = 0{\cdot}5269\,\mu$ = line E.)	Penetrating Power. $\left(\frac{1}{a}\right)$
	Dry Objectives. ($n = 1$)	*Water-Immersion* Objectives. ($n = 1{\cdot}33$.)	*Homogeneous Immersion* Objectives. ($n = 1{\cdot}52$.)			
1·52	..	..	180° 0′	2·310	146,528	·658
1·50	..	..	161° 23′	2·250	144,600	·667
1·48	..	..	153° 39′	2·190	142,672	·676
1·46	..	..	147° 42′	2·132	140,744	·685
1·44	..	..	142° 40′	2·074	138,816	·694
1·42	..	..	138° 12′	2·016	136,888	·704
1·40	..	..	134° 10′	1·960	134,960	·714
1·38	..	..	130° 26′	1·904	133,032	·725
1·36	..	..	126° 57′	1·850	131,104	·735
1·34	..	..	123° 40′	1·796	129,176	·746
1·33	..	180° 0′	122° 6′	1·770	128,212	·752
1·32	..	165° 56′	120° 33′	1·742	127,248	·758
1·30	..	155° 38′	117° 34′	1·690	125,320	·769
1·28	..	148° 28′	114° 44′	1·638	123,392	·781
1·26	..	142° 39′	111° 59′	1·588	121,464	·794
1·24	..	137° 36′	109° 20′	1·538	119,536	·806
1·22	..	133° 4′	106° 45′	1·488	117,608	·820
1·20	..	128° 55′	104° 15′	1·440	115,680	·833
1·18	..	125° 3′	101° 50′	1·392	113,752	·847
1·16	..	121° 26′	99° 29′	1·346	111,824	·862
1·14	..	118° 0′	97° 11′	1·300	109,896	·877
1·12	..	114° 44′	94° 56′	1·254	107,968	·893
1·10	..	111° 36′	92° 43′	1·210	106,040	·909
1·08	..	108° 36′	90° 33′	1·166	104,112	·926
1·06	..	105° 42′	88° 26′	1·124	102,184	·943
1·04	..	102° 53′	86° 21′	1·082	100,256	·962
1·02	..	100° 10′	84° 18′	1·040	98,328	·980
1·00	180° 0′	97° 31′	82° 17′	1·000	96,400	1·000
0·98	157° 2′	94° 56′	80° 17′	·960	94,472	1·020
0·96	147° 29′	92° 24′	78° 20′	·922	92,544	1·042
0·94	140° 6′	89° 56′	76° 24′	·884	90,616	1·064
0·92	133° 51′	87° 32′	74° 30′	·846	88,688	1·087
0·90	128° 19′	85° 10′	72° 36′	·810	86,760	1·111
0·88	123° 17′	82° 51′	70° 44′	·774	84,832	1·136
0·86	118° 38′	80° 34′	68° 54′	·740	82,904	1·163
0·84	114° 17′	78° 20′	67° 6′	·706	80,976	1·190
0·82	110° 10′	76° 8′	65° 18′	·672	79,048	1·220
0·80	106° 16′	73° 58′	63° 31′	·640	77,120	1·250
0·78	102° 31′	71° 49′	61° 45′	·608	75,192	1·282
0·76	98° 56′	69° 42′	60° 0′	·578	73,264	1·316
0·74	95° 28′	67° 36′	58° 16′	·548	71,336	1·351
0·72	92° 6′	65° 32′	56° 32′	·518	69,408	1·389
0·70	88° 51′	63° 31′	54° 50′	·490	67,480	1·429
0·68	85° 41′	61° 30′	53° 9′	·462	65,552	1·471
0·66	82° 36′	59° 30′	51° 28′	·436	63,624	1·515
0·64	79° 35′	57° 31′	49° 48′	·410	61,696	1·562
0·62	76° 38′	55° 34′	48° 9′	·384	59,768	1·613
0·60	73° 44′	53° 38′	46° 30′	·360	57,840	1·667
0·58	70° 54′	51° 42′	44° 51′	·336	55,912	1·724
0·56	68° 6′	49° 48′	43° 14′	·314	53,984	1·786
0·54	65° 22′	47° 54′	41° 37′	·292	52,056	1·852
0·52	62° 40′	46° 2′	40° 0′	·270	50,128	1·923
0·50	60° 0′	44° 10′	38° 24′	·250	48,200	2·000

EXAMPLE.—The apertures of four objectives, two of which are dry, one water-immersion, and one oil-immersion, would be compared on the *angular* aperture view as follows:—106° (air), 157° (air), 142° (water), 130° (oil).

Their actual apertures are, however, as ·80 (air), ·98 (air), 1·26 (water), 1·38 (oil), or their numerical apertures.

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